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14. ABSTRACT

This TOP describes a systematic approach detailing test methodology for Flight Termination Receiver laboratories to conduct flight worthiness certification testing of Enhanced Flight Termination Receivers (EFTRs). The detailed information contained in this document specifies the entire EFTR Range Certification process in WSMR and includes procedures for EFTR receiving, inspecting, handling, required certification testing, packing and shipping. The test methodology defined here is applicable to all Enhanced Flight Termination Receivers (EFTRs) no matter where they are tested or where they are intended to be flown.

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US ARMY TEST AND EVALUATION COMMAND
TEST OPERATIONS PROCEDURE

*Test Operations Procedure (TOP) 05-2-543 25 July 2011
DTIC AD No.

ENHANCED FLIGHT TERMINATION RECEIVER (EFTR) RANGE CERTIFICATION TESTING

* Approved for public release; distribution unlimited.

1. SCOPE.

This Test Operations Procedure (TOP) describes a systematic approach detailing test methodology for Flight Termination Receiver (FTR) laboratories at the US Army White Sands Missile Range (WSMR) to conduct flight worthiness certification testing of Enhanced Flight Termination Receivers (EFTRs). The detailed information contained in this document specifies the entire EFTR Range Certification process and includes procedures for EFTR receiving, inspecting, handling, required certification testing, packing, and shipping. These test procedures are set forth to assist the test laboratories and range users by establishing the EFTR TOP basis. The test methodology defined here is applicable to all EFTRs no matter where they are tested or where they are intended to be flown. It is the intent of this standard to provide commonality for the testing methodology of EFTRs.

1.1 Purpose.

The purpose of this document is to provide uniform procedures that will allow for a thorough and detailed systematic approach to EFTR testing that is consistent throughout the various ranges that certify Flight Termination Receivers. In addition, the intent is to produce consistent range results and to document and standardize the EFTR Range certification process.

1.2 Applicability.

This document applies to all programs launching from Department of Defense (DoD) test ranges and National Aeronautics and Space Administration Wallops Flight Facility (NASA-WFF) that use EFTRs for the Flight Safety function. The basis of authority is derived from Department of Defense Directive (DoDD) 3200.11[1]* which establishes the Major Range and Test Facility Bases (MRTFBs) responsibilities for test and evaluation activities and NASA Handbook 1700.1[2] establishes safety responsibility for NASA-WFF. This TOP applies to all ranges using EFTRs for the Flight Safety Function. The requirements of this standard apply to all range safety EFTRs. If the procurement specification requires the EFTR to have a special or peculiar feature that is not addressed in this standard, that feature must also be tested. The absence of a test methodology in this standard does not infer that the attribute does not need to be tested. Any EFTR feature(s) that can damage the receiver such as overvoltage, direct current (DC)-short circuit, or reverse polarity must NOT be performed for flight worthiness certification. Any test that will degrade or damage any part of a receiver shall not be performed. Each test design must be approved by the Lead Range Safety Office (LRSO) as to requirements and methodology.

1.3 Pass/Fail Criteria.

This TOP outlines the requirements for each test and establishes the pass or fail criteria. Since specific missile systems and range requirements vary, the actual EFTR design requirements may also vary. The basic electrical design and performance requirements are contained in latest Range Commanders Council (RCC) Document 319, Flight Termination Systems Commonality Standard [3]. Actual specifications for vehicle-peculiar requirements are outlined in the

* Superscript numbers correspond to those in Appendix G, References.

procurement specification or contract. All three documents must be congruent and must be reviewed for specific pass or fail criteria. Prior to the start of ANY test, all procedures must be approved by the LRSO. This requirement applies regardless of who is performing the test or where the test is being conducted.

1.4 Special EFTR Features.

EFTRs that contain features not intended for range safety use will also be tested. Any failures or out-of-tolerance conditions of these features will be handled and reported in the same manner as if they were specifically intended for range safety use. For the purpose of this standard, the Enhanced Flight Termination Receiver will be referred to as an EFTR, or a unit under test (UUT). The certification procedure and process described in this standard assumes certification, recertification, and reuse to be the same process.

1.5 Limitations.

This document applies to EFTRs which are encrypted and digitally based receivers, and does not cover the analog-tone based flight termination receivers.

1.6 Accountability.

The Receiver Test Certification Laboratory shall complete the entire certification test process of an FTR within 30 days. However, special consideration must be allowed for newly developed receivers that are not in the receiver laboratory's automated tester data base. For newly developed receivers, the test certification laboratory shall provide an estimated time development time period and a cost estimate to setup the data base and to build any special cabling that will be needed for specific receivers.

2. FACILITIES AND INSTRUMENTATION.

2.1 Facilities.

The test facilities, building, and/or test center/shelter shall provide minimal conditions that are suitable for receiver testing. The facility shall maintain a clean, healthy, and safe environment for its employees and provide a safe and secure location for the temporary storage of receivers.

a. Security. Adequate security must be provided that includes locking doors and proper storage locations for secure hardware such as the Data Transfer Devices (DTD's) that are provided by the National Security Agency (NSA), and must be secured. NSA requires that the DTD's be secured at all times by being placed in a locked room or storage bin.

b. Air Conditioning. A climate control system must provide adequate air temperature conditioning to ensure adequate cooling for all test equipment. The test room shall have no ventilation other than the air conditioning and return. The air conditioning is used to control the temperature and humidity of the room with consistent air circulation patterns within the room.

c. Work Space. Adequate work space shall be provided that is conducive of an efficient and safe work environment. Sufficient and adequate work tables and storage cabinets shall be provided. The facility shall have a separate work area for shipping and receiving of receivers from the test room. The test facility shall provide a clean, safe, secure, and environmentally controlled work space.

d. Electromagnetic Interference (EMI) Shielding. All testing shall be conducted inside an Electromagnetic Interference/Electromagnetic Compatibility (EMI/EMC) shielded room to prevent emission and susceptibility to outside sources of Electromagnetic Interference/Radiofrequency Interference (EMI/RFI). The room or test area shall include full shielding that includes EMI finger shield gaskets on doors.

2.2 Test Equipment/Hardware.

EFTR test equipment consists of three systems; the temperature conditioning equipment (climatic chambers), automated tester(s), and the computer controller/data acquisition system. In addition to these three systems an array of test accessories are used to test and maintain the automated tester(s). All test instruments used to perform the tests required by this standard will be fully capable of providing the measurement and stimulus ranges of required tests. All instruments will provide accuracy to within one-tenth of the tolerances of the measured variable or the provided stimulus. Figure 1 shows a block diagram of a typical EFTR Automated Tester.

2.3 Test Hardware Calibration.

All test measuring instruments used to perform the required tests will be calibrated prior to usage. All measuring test instruments must be periodically (once a year minimum) sent to an accredited organization/facility that provides instrument calibration services with traceability to National Institute of Standards and Technology (NIST). Instrument calibration process must include repair or removal of faulty or out of tolerance instrument conditions. Calibration certificates or documentation and calibration service records must be provided and readily available at the test facility. A recall notice for equipment approaching its calibration due date must be in place. For calibration laboratories, the program for calibration of equipment shall be designed and operated so as to ensure that calibrations and measurements made by the laboratory are traceable to the SI (Systeme International) units of measurement or to the NIST. Traceability of measurement shall be assured by the use of calibration services from laboratories that can demonstrate competence, measurement capability, and traceability. The calibration certificates issued by these laboratories shall show there is a link to a primary standard or to a natural constant realizing the SI unit by an unbroken chain of. If the calibration testing is performed at a non-military laboratory, the final test report must include a certificate of conformance that certifies the NIST traceability. All test laboratories must contain a log/list of the test instrumentation used and must have a facility calibration process/program that is continuously adhered to. The calibration report or calibration sticker on hardware will include, as a minimum, the following information: name of instrument, manufacturer's identification, serial number, part number or model number, and calibration due date.

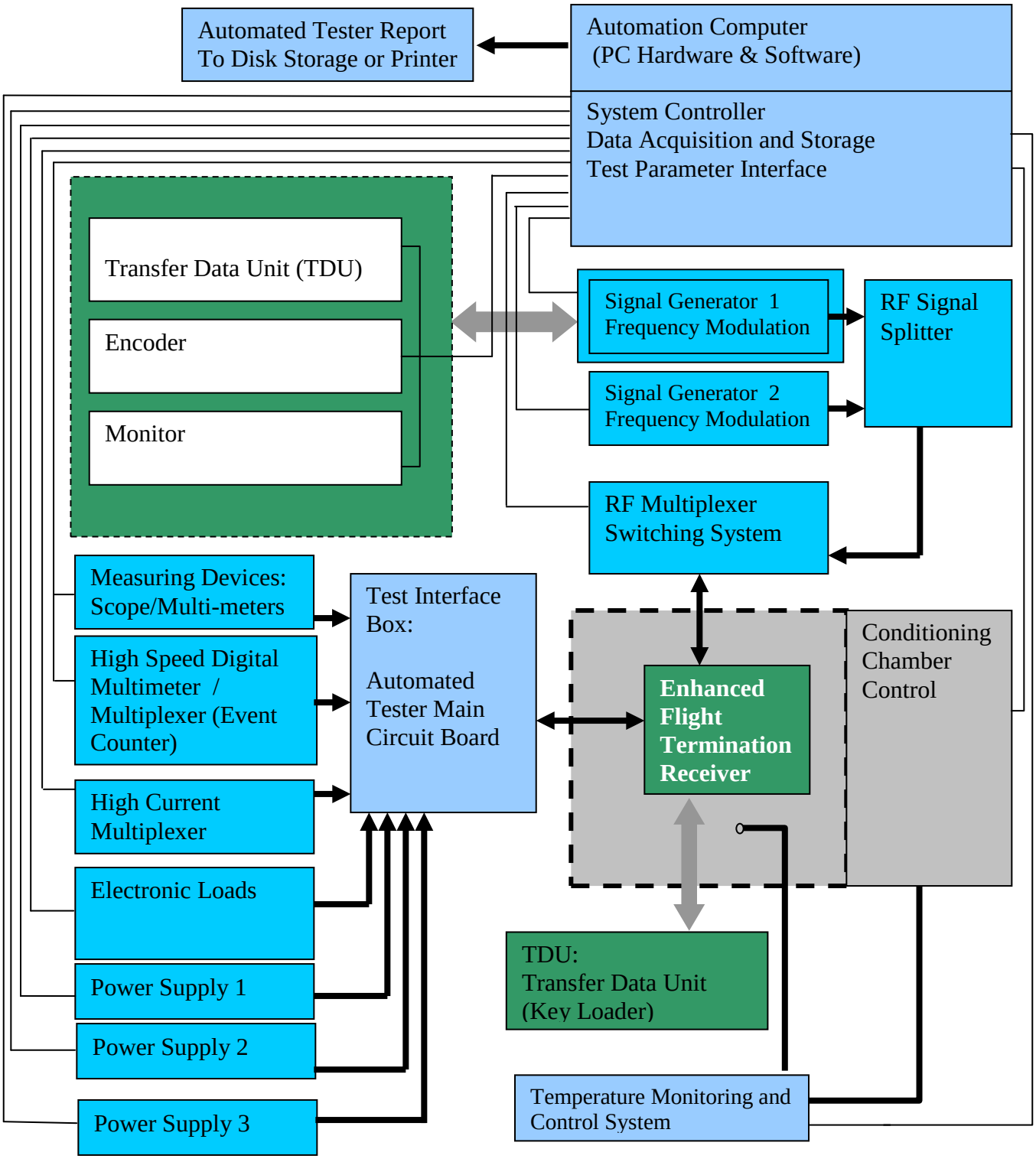

Figure 1. EFTR automated tester block diagram.

2.4 Test Hardware Inspection.

All test hardware that interfaces test equipment to test samples must be inspected periodically (at least once a year) to insure proper operation and to prevent inadvertent damage to test samples. All test cabling and connectors that interconnect the EFTRs to test hardware or instrumentation must be periodically replaced to insure the wear and tear of test reuse hardware (e.g., connectors) does not damage new EFTR test samples. The screening out of interconnect hardware must be tailored to each test facility based on connector frequency usage. The Subminiature A (SMA) connector is intended for use on semi-rigid cables and in components which are connected infrequently. A few hundred interconnect cycles are possible if performed carefully. Care should be taken to join connectors straight-on. Prior to making a connection, inspect the mating ends to assure that the center socket is in good condition (not bent, recessed, or missing). All EFTR interconnect hardware shall be periodically inspected and a system must be in place to remove worn out hardware that can damage new EFTR hardware.

2.5 Software Description.

Quality assurance and quality control processes shall be in place to ensure the reliable operation of the software being used. Software must be written to perform the intended automated test process with quality assurance methods and techniques in place that aim at achieving or building quality into the software. A set of software quality control procedures must be used to ensure that the EFTR automated tester software product will meet its quality goals and to continually improve/modify the software product as needed to meet changing receiver test needs. The quality control program will be tailored to test the software to perform well in unforeseeable scenarios and to keep a relatively low defect rate through the software generation changes. Verification and Validation (VV) and software testing is required using “dummy” receiver test samples specifically designated for automated tester testing. The VV testing process shall include test conditions that improve quality assurance, such as audits or comparisons, to the standard software. In addition, software quality control or a control of products shall be in place to ensure correct software versions are being used.

2.6 Required Test Hardware Accessories.

a. Receiver Interconnect Test Cables. Interconnect cables are used to interconnect the receivers to test hardware/instrumentation. Note that, all interconnecting cabling (radio frequency (RF), signal, test leads, breakout boxes, and DC current loading) must be periodically inspected and placed in a screening program that ensures the removal of warn out cables.

b. Electrostatic Discharge (ESD) Equipment. The test area must be fully protected from the ESD environment to prevent damage to test samples and receiver laboratory hardware due to an inadvertent static discharge. All ESD equipment that is used to dissipate static electricity and protect test samples must be tested and inspected daily to insure proper function. ESD protection hardware shall consist of test room grounding points (bars) that are not part of the building electrical system and are independently and directly connected to a grounding rod or grounding mechanism. The test area shall have wrist, shoe, or ankle grounding straps, a grounded workstation surface (pads), and ample grounding ports available for functional/comfortable

access. The EFTR laboratory shall partake of an ESD prevention practice that eliminates and reduces the generation of ESD and neutralizes ESD hazards. The practice shall include properly grounding (ESD wrist-stat) of personnel unpacking and handling receiver(s) and the environment/surfaces that the units are to be placed on shall be ESD protection compliant. Handling surfaces shall comply with conductive materials having low electrical resistance, generally less than 1×10^5 ohms/sq (surface resistivity) and 1×10^4 ohm-cm (volume resistivity). Ensure the personnel protection wrist-stats are properly tested prior to each use (i.e., must have a grounding tester). The test laboratory ESD compliance program shall be based on proven ESD control practices such as American National Standards Institute (ANSI)/ESD S20.20-Standard for the Development of Electrostatic Discharge Control Program[4]. The EFTR test room shall have in place proper ESD controlled room grounding and prevention (clothing) practices that optimize ESD discharge protection.

c. Heat Sink Plates. All FTRs being tested must be bonded to a heat sink plate during all receiver operational test processes that include high or ambient temperatures. These plates are used to dissipate receiver self generating heat that is created by current flow and dissipated on the case during functional tests. This is required to insure that the receiver's self generating heat does not reach critical levels that can possibly damage receiver(s) or create adverse test results.

3. REQUIRED TEST CONDITIONS.

3.1 Receiving EFTRs.

Each test facility must establish one receiver laboratory shipping address where all EFTRs to be tested will be shipped to. No other address shall accept or receive EFTRs. Ensure address is complete with laboratory personnel name(s), building and room number. The shipper is solely responsible for tracking and recovering miss-addressed, and/or lost shipments originating from their location.

3.2 Incoming Receipt and Inspection.

Upon package arrival, receiver laboratory personnel will perform the following actions:

a. Shipping Documentation. The receiving facility must first review the packing list. Packing slips should include model and serial number of the receivers in the shipping box. If this information is missing, the shipper needs to be contacted and the missing information faxed or emailed. All shipping documentation must be accurate and complete prior to acceptance of test samples.

b. Unpack Shipping Box Contents. Open cartons and examine the contents and compare box contents with the packing slip. If there are any discrepancies with the receiver(s) in the shipping box, versus the contents description/list on the packing slip, the receiver laboratory technician/engineer must inform the shipping agency and correct the documentation anomaly. All documentation differences must be resolved before proceeding with testing.

c. EFTR Visual Inspection: A visual inspection of each EFTR shall be performed upon arrival of test sample(s). An inspection sheet is provided in Figure 2. Laboratory personnel shall annotate the inspection sheet and document any irregularities. Verify that the units are packed in anti-static bags, and all connectors have protective plastic coverings. The EFTR connector(s) should be inspected for bent/worn/dirty pins and for any damage on the connector housing. Pins should be closely inspected for debris and any other degradation that could impede the receiver's ability to function. RF connector(s) should be inspected for wear, cross threading, and checked for debris and deformation. The receiver lab test personnel shall document and inform project personnel of any discrepancies that are encountered during the inspection process before these units are tested and shall not attach anomalous test samples to test hardware until given approval to proceed with the test.

Inspection Sheet

Date Inspected_____ Program_____
RCVR Type_____ S/N_____

	Acceptable	Defective
1. Packing (Anti-Static Bags, Connector Covers)	_____	_____
2. RF Connector (Wear, Cross Threading)	_____	_____
3. Pin Connector(s) (Bent, dirt-foreign object, housing integrity)	_____	_____
4. RCVR Label (Legible, Accurate, Complete)	_____	_____
5. Scratch and Dents (Indication of Mistreatment)	_____	_____
6. Corrosion/stains/damage marks (Structural Integrity)	_____	_____

Inspection Notes: _____
_____
_____
_____

Figure 2. Inspection sheet.

d. Inventory Control. All test hardware received must be logged into an inventory control database. This database should consist of a log entry number; date EFTR(s) were received; name of person receiving the EFTR(s); the name of the company or organization that owns the EFTR(s); the name of the program that will be the end user of the EFTR(s); the EFTR manufacture, model, and serial number; shipping information (method of shipment); and storage location (bin) number assigned to the EFTR during the laboratory certification process (if applicable).

e. Temporary Storage. Prepare EFTR unit for certification testing or place in proper temporary storage location for future disposition. The receivers shall be properly stored in the receiver laboratory to insure that they are not damaged and are secure. Receivers must be stored in anti-static bags or placed on nonconductive counters in the test screen room.

f. Test History. If a receiver has been previously certified by a test range laboratory, then previous range certification test data must be incorporated as part of the current certification process being conducted. The previous certification data shall be obtained and used to compare current certification data. This will allow the laboratory to assess receiver performance and determine if any degradation has occurred.

3.3 Test Temperature.

Unless otherwise specified, all tests will be conducted at high and low temperatures followed by ambient temperature testing. The high and low test temperature shall be -40 and +70 ºCelsius (C) (-40 and 158 ºFahrenheit (F)) unless otherwise specified. The ambient temperature shall be within the NIST temperature range of 20 ºC ± 5 ºC (68 ºF ± 9 ºF). When temperature conditioning, the test item(s) shall be totally surrounded by an envelope of conditioned air (except at necessary support points). The allowable temperature tolerance of the test section measurement system and the gradient throughout this envelope shall be within ± 2 ºC (4 ºF) of the required test temperature. Adequate time will be allotted for stabilization prior to testing at each temperature. Temperature stabilization is attained when the temperature of the operating part of the test sample, considered to have the longest thermal lag, is changing by no more than 2 ºC (4 ºF). Refer to Table 1 for specific test temperature requirements.

TABLE 1. EFTR STANDARD TEST PARAMETERS (STP)

ITEM	PARAMETER
RF center frequency	Assigned ± 0.005 percent
RF input level	Specified minimum RF guaranteed threshold sensitivity level (at the EFTR input, NOT the measured threshold sensitivity level). Accuracy of ± 0.5 decibel (dB) resolution of ± 0.1 dB
Modulation deviation	± 50 kilohertz (kHz) ± 1 kHz
EFTR input DC voltage	Specified nominal ± 0.5 volt (V)DC
EFTR input DC current	Current limited to the specified current plus 10 percent (nominal)
BIT Rate	7200 bits per second (BPS) ± 0.1%
BIT Duty Cycle	50% ± 0.1%
Timing	±0.1 millisecond
Temperature	Laboratory ambient
Humidity	Laboratory ambient

3.4 Over Temperature Protection.

All automated test systems that are capable of running without an operator must be equipped with a two layer/level over-temperature protection system. One system can be designed into the conditioning unit. The second system must be independent of the conditioning chamber and be capable of disabling the conditioning system.

3.5 Test Instrumentation Warm-up Time.

Prior to the beginning of the test process, the test instrumentation will be allowed a warm-up period appropriate to the prescribed time specified by the manufacturer. Unless otherwise recommended by a particular instrument vendor, the minimum warm-up time will be 30 minutes.

3.6 RF Environment.

All tests will be conducted in an EMI shelter that shields sensitive electronic test hardware and test samples from the effects of EMI. All test equipment and test samples shall be in the RF shield protection area during testing. The shelter shall provide greater than 40 dB of shielding effectiveness at frequencies between 400 and 450 megahertz (MHz).

4. TEST PROCEDURES.

4.1 Attach EFTR to Tester.

Place EFTR on the tester heat sink in the appropriate conditioning location for the specific test to be performed. Inspect the EFTR and test cabling connector pins and look for any damage. If no damage is found, attach RF-SMA connector with 5/16 inch torque preset wrench. Attach the power/signal cable (Sub-Micro Miniature D) and lightly tighten connector screws until they bottom out.

4.2 Temperature Conditioning.

Condition the EFTR as specified in test requirements for the specific program. Insure that the target temperature is reached within the tolerance level and ramp-up/down rates are not exceeded.

4.3 Standard Test Parameters.

Any standard test parameter (STP) not specified as a test variable for a specific test, will be maintained at its nominal value. The STPs for EFTR testing are specified in Table 1. All power supplies used to provide test current/voltage to the EFTR will provide current limiting and overvoltage protection. When a test requires that the EFTR be tested at DC power supply extremes, the minimum and maximum voltages specified in the procurement specification will be used. If none are specified, the minimum will be 22 VDC and the maximum will be 34 VDC.

4.4 Receiver Standard Configuration Load.

The following conditions shall be used for the standard configuration listed below. Note that all configuration parameters will be listed in decimal (base- 10) notation unless otherwise noted and if assigned center frequency (Fo) is not known, then use Fo = 425 MHz.

Item	Configuration
Configuration location	0
Transmitter identification (TXID)	2
Range identification (RID)	1
Vehicle identification (VID)	11
Center frequency	Assigned Fo
Wireless configuration on/off	ON
Fail safe on/off	OFF
Terminate output	Constant voltage
Command counter	On
Loss of power fail safe voltage (LOP FS Voltage)	23.0 VDC
Loss of command link fail safe duration (LOCL FS Duration)	5 second (s)

4.5 Command Counter Reset.

Prior to each test the command counter must be set to zero. This can be performed by either of the following methods:

a. Transmit a command counter clear with the command counter set to the next command counter value.

b. If wireless configuration is turned ON, transmit a wireless enable command with the configuration set to 0 and then transmit a wireless commit command with the configuration set to 0.

c. Reload the standard configuration and set the active configuration to 0.

4.6 Keying.

Prior to the start of testing, the EFTR must be keyed with the same key used to encrypt the Enhanced Flight Termination Systems (EFTS) message. To ensure identical keys, the key identifications (IDs) should be compared to ensure they match.

4.7 Clearing Key.

Upon completion of testing, zeroize the EFTR key and verify zeroization by reading and verifying the key ID is "3333333". Send a No-Op message with the Check Channel ON and verify the EFTR does not respond.

4.8 Electrically Erasable (EE) Memory Writes.

Upon completion of testing, read and record the number of remaining "EE Writes" for the storage memory.

4.9 Receiver Standard Command Logic.

Unless otherwise specified and approved by the LRSO, the EFTR will not produce a command output under any condition or set of conditions except as indicated in Table 2.

TABLE 2. EFTR COMMAND OUTPUTS

COMMAND	EFTR OUTPUT
ARM*	ARM
TERMINATE*†	ARM and TERMINATE (Must be preceded by an ARM Command)
OPTIONAL*	OPTIONAL
MONITOR	MONITOR
CHECK CHANNEL Bit	CHECK CHANNEL
* OPTIONAL, ARM, and TERMINATE commands are latching. The only ways to clear a latched command are to cycle power, send an UNLATCH command, or use the WIRELESS CONFIGURE and WIRELESS COMMIT commands to change the active configuration. The MONITOR command and CHECK CHANNEL output will be pulsed each time the message is received. † The ARM command must be latched prior to receiving the TERMINATE command or the TERMINATE output will not turn on.	

4.10 Step Sizes.

During certain tests, the type of stimulus signal will be changed according to the increment levels listed in Table 3. The incremental adjustments listed under initial measurements will be used until the measurement area is refined, and then the refined measurement values will be used. Note that anytime a stimulus is varied, the manual rate will be in BOLD lettering and the suggested automated rate will be in parentheses.

TABLE 3. INCREMENT LEVELS FOR STIMULUS SIGNALS

SIGNAL TYPE	INITIAL MEASUREMENTS	REFINED MEASUREMENTS
RF Amplitude	1 dB	0.1 dB
RF Frequency	10 kHz	1 kHz

4.11 Stable Output.

The criteria for determining a stable output of the UUT varies according to the type of testing procedure used. For manual operations, a stable output requires no interruptions in the channel output over a five-second period. For automatic operations (computer controlled) a stable output requires at least ten confirmed outputs with a minimum 50-millisecond interval between each confirmed output. Any sample performed during the 500 millisecond interval, that is not the correct level, will indicate the output is not stable.

4.12 Specified Threshold Sensitivity.

The EFTR specified RF threshold sensitivity is the minimum RF level specified in the procurement document. This specified level is also known as the “guaranteed threshold sensitivity level”.

4.13 Measured RF Threshold Sensitivity.

The EFTR measured RF threshold sensitivity is the actual measured RF level where the UUT meets a message error rate (MER) of 10^{-4}.

4.14 Message Error Rate (MER).

The command valid output of the EFTR is turned ON for 19.9 milliseconds and OFF for 100 microseconds for each properly decoded received uplink message. The message error rate is the ratio of missed messages to the number of sent messages.

4.15 Test Units/Sequence.

This standard is intended for application to flight instrumentation hardware. All units must be safeguarded to protect against inadvertent damage from physical and electrical elements. Testing that cannot be completed in one test period will be annotated in the test report and other necessary documentation. Any restart of testing will begin with the first step of the last uncompleted test sequence.

5. EFTR FUNCTIONAL TESTS.

Perform the following tests listed in Table 4. Each individual test is described in this section. Note that the number of re-uses possible will be determined for each program depending on conditions of use.

TABLE 4. EFTR FUNCTIONAL TESTS

TEST NO.	TEST NAME	TEST PARAGRAPH	QTP[a]	ATP[b]	CERT/RECERT
1	Continuity and Isolation	5.1	T	T	
2	Input Current and Voltage	5.2	T	T	
3	Power Cycling (DC)	5.3	T	T	
4	Abnormal Voltage	5.4	T	T	
5	Maximum Usable RF Level Dynamic Range	5.5	T	T	
6	RF Threshold Sensitivity	5.6	T	T	
7	Command Interface Requirement Document Verification	5.7	T	T	
8	Acquisition/Reacquisition Time	5.8	T	T	
9	Inverted Modulation	5.9	T	T	
10	Signal Strength Telemetry Output	5.10	T	T	
11	Operational Bandwidth	5.11	T	T	
12	Continuous Wave (CW) Bandwidth	5.12	T	T	
13	CW Peak to Valley Ratio	5.13	T	T	
14	Self Test	5.14	T	T	
15	Receiver Status Telemetry Output (RSTO)	5.15	T	T	
16	Fail-safe	5.16	T	T	
17	Leakage Current	5.17	T	T	
18	Output Load Characteristics	5.18	T	T	
19	Image and Spurious Response Rejection	5.19	T	T	
20	Center Frequency/Tuneability	5.20	T	T	

Notes: a = Quality Test Procedure
b = Acceptance Test Procedure

5.1 Continuity and Isolation (Test Number 1).

a. Purpose. This test verifies the isolation between various grounds, inputs and outputs, and minimum continuity (grounding) for those circuits that should be connected, such as chassis/case. Note that only the measurements that provide meaningful data for EFTR health and troubleshooting need be made. The actual measurement list must be approved by the LRSO.

b. Requirement. The isolation and grounding resistance between case ground and all power leads; between signal outputs and command outputs, including returns; and between power leads and signal leads, including returns, are within the requirements that are specified in the applicable component specification.

c. Test Equipment Requirements. The ohmmeter must have at least 3 ½ digits of measurement display resolution, a range of at least 0.001 to 10 mega ohms, and an absolute worst-case resistance accuracy of 2 percent.

d. Setup. Disconnect the UUT from the test set (no DC power applied).

e. Procedure. Using an ohmmeter, measure and record the isolation measurements. Note that if the EFTR connector pins are the test points, pin savers should be used to prevent damage to the pins. If a break-out-box (BOB) assembly is used, it must have been tested previously, and its losses known and appropriate corrections made to the final data. The use of the BOB is the preferred method because it assists in the prevention of damage to the EFTR connector pins.

f. Pass/Fail Criteria. The pass/fail criteria for this test must be established at the time of design and will be defined in the test procedure.

5.2 Input Current and Voltage (Test Number 2).

a. Purpose. This test verifies that EFTR power consumption is within specified limits in standby and commanded modes, and that the EFTR functions normally at the specified voltages.

b. Requirement. The current will not exceed the specified inrush current, or the specified current in the standby and commanded modes, at the specified voltages.

c. Test Equipment Requirements. The DC current meter must have sufficient resolution to display the reading with a DC accuracy of one milliampere or better, and a response time of at least 1 millisecond.

d. Setup. Connect the UUT to the test equipment as shown in Appendix A and Table 5.

TABLE 5. TEST SETUP FOR INPUT CURRENT AND VOLTAGE

DEVICE	SETTINGS
RF Generator	
Power Output	Off, then -47 dBm
Frequency	F_o
Deviation	± 50 kHz
Modulation	On
UUT Configuration	
Configuration Location	0
Transmitter ID (TXID)	2
Range ID (RID)	1
Vehicle ID (VID)	11
Command Counter (CC)	0
Failsafe	Off
Power Supply	
Voltage	22V, 28V, and 36V

NOTE: At each step, ensure that the proper command outputs are ON but keep the load on the command outputs to the minimum required to verify the proper state.

e. Procedure.

(1) Pull up EFTS graphic user interface (GUI) (Figure 3).

(2) Click “Receiver Power On”.

(3) Terminate the monitor outputs into their specified loads.

(4) Set the input voltage to 22 V on power supply #2 and press set.

(5) With no RF input applied (standby), measure the inrush and steady state input current.

(6) Set the RF signal level to -47 dBm.

(7) Send a “NO-OP” command.

(8) Send a CHECK CHANNEL.

(9) Measure and record the input current.

(10) Drop the CHECK CHANNEL.

(11) Send a MONITOR command.

(12) Measure and record the input current.

(13) Drop the MONITOR command.

(14) Send an OPTIONAL command.

(15) Measure and record the input current.

(16) Drop the OPTIONAL command.

(17) Send a COMMAND UNLATCH command.

(18) Send an ARM command.

(19) Measure and record the input current.

(20) Send a TERMINATE command.

(21) Measure and record the input current.

(22) Drop the TERMINATE command.

(23) Send a COMMAND UNLATCH command.

(24) Set the input voltage to 28 V on power supply #2 and press set.

(25) Repeat steps 5 through 23.

(26) Set the input voltage to 36V on power supply #2 and press set.

(27) Repeat steps 5 through 23.

f. Pass/Fail Criteria. The receiver will decode the commands correctly at the various input voltages, and the inrush, standby, and commanded mode steady state input currents will not exceed their specified values.

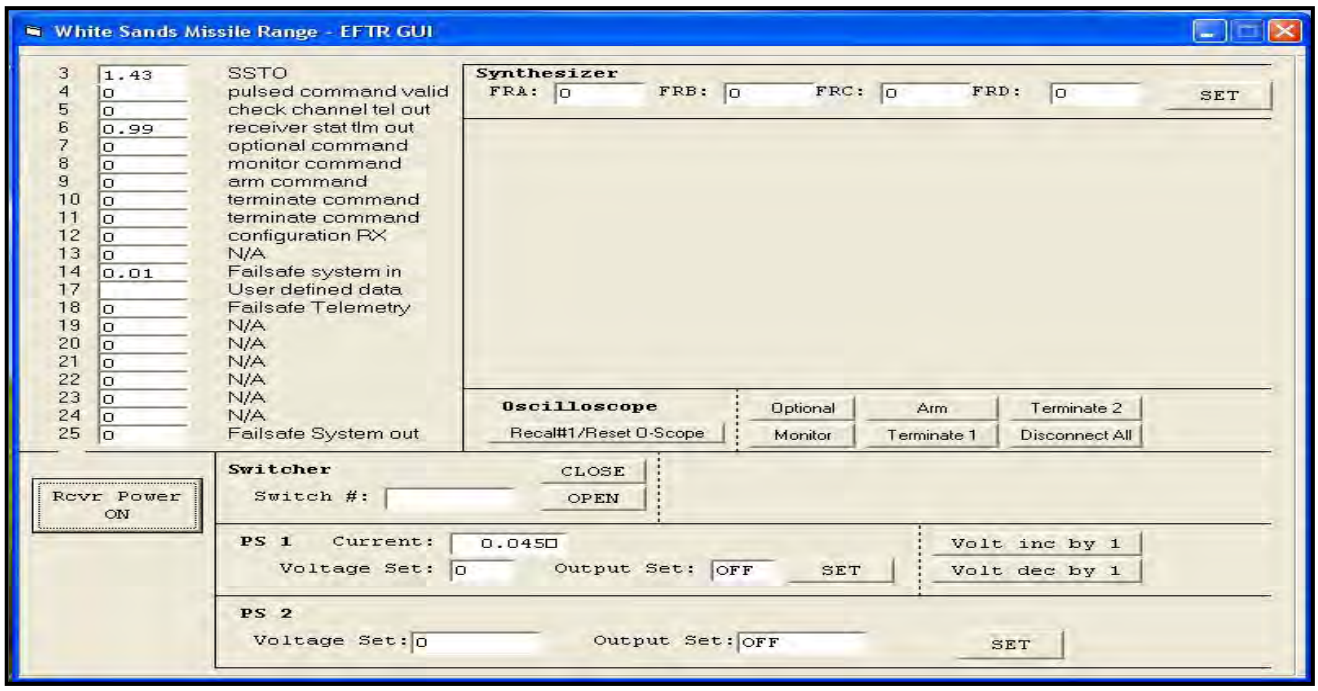

Figure 3. EFTS GUI[a]

[a]Figure 3 Explanation

The WSMR GUI displays the EFTR outputs and allows the test operator some test equipment control via the computer display. The upper left corner displays voltage readings of pins 3-25 of the DB25 test connector. Each pin value has an annotation to describe the name of each receiver output. These data are updated every half second.
"Rcvr Power ON" button. This applies power to the receiver as set by power supply #1 (PS 1) and also enables the entire panel. This button must be pressed first before anything on the GUI is active.
Oscilloscope: "Optional" button. Clicking this button closes the essential switches in the automated test equipment (ATE) to see the optional output of the receiver on the oscilloscope Ch 1. It also connects the output to the electronic load (HP6060) which will be used to apply a 1 amp load.
Oscilloscope: "Monitor" button. Clicking this button closes the essential switches in the ATE to see the monitor output of the receiver on the oscilloscope Ch 1. It also connects the output to the electronic load (HP6060) which will be used to apply a 1 amp load.
Oscilloscope: "Arm" button. Clicking this button closes the essential switches in the ATE to see the arm output of the receiver on the oscilloscope Ch 1. It also connects the output to the electronic load (HP6060) which will be used to apply a 1 amp load.
Oscilloscope: "Terminate 1" button. Clicking this button closes the essential switches in the ATE to see the terminate 1 output of the receiver on the oscilloscope Ch 1. It also connects the output to the electronic load (HP6060) which will be used to apply a 1 amp load.
Oscilloscope: "Terminate 2" button. Clicking this button closes the essential switches in the ATE to see the terminate 2 output of the receiver on the oscilloscope Ch 1. It also connects the output to the electronic load (HP6060) which will be used to apply a 1 amp load.
Oscilloscope: "Disconnect all" button. Clicking this button disconnects any connections that were made during the previous 5 buttons.
Switcher: "Close" button. Clicking this button closes any switch number that is specified by the user.
Switcher: "Open" button. Clicking this button opens any switch number that is specified by the user.
PS 1: "Set" button. Clicking this button sets the input voltage of the EFTR as defined by the user.
PS 1: "Volt inc by 1" button. Clicking this button increments the current voltage setting of PS 1 by 1 volt.
PS 1: "Volt dec by 1" button. Clicking this button decrements the current voltage setting of PS 1 by 1 volt.
PS 2: "Set" button. Clicking this button sets the voltage output of PS 2 as defined by the user.

5.3 Power (DC) Cycling (Test Number 3).

a. Purpose. This test verifies that the EFTR does not degrade or fail after repeated application and removal of primary DC power, and that the transient outputs on the command outputs during the application and removal of power meet the specification.

b. Requirement. The EFTR will not be damaged by momentary interruptions in the DC power input, and any transient command outputs generated during the application or removal of input power will meet the EFTR specification.

c. Test Equipment Requirements. A differential oscilloscope or equivalent is required to monitor the outputs for transient responses with a voltage resolution of 0.01 volts and a time resolution of 1 μsecond.

d. Setup. Connect the UUT to the test equipment as shown in Appendix A and Table 6.

TABLE 6. TEST SETUP FOR POWER (DC) CYCLING

DEVICE	SETTINGS
RF Generator	
Power Output	Off, then -107 dBm
Frequency	F_o
Deviation	± 50 kHz
Modulation	On
UUT Configuration	
Configuration Location	0
Transmitter ID (TXID)	2
Range ID (RID)	1
Vehicle ID (VID)	11
Command Counter (CC)	0
Failsafe	Off
Power Supply	
Voltage	Nominal specified voltage (the power will be interrupted 25 times during the test)

NOTE: The command outputs will be terminated into the load specified in the EFTR specification and monitored with a differential oscilloscope or equivalent. The ON/OFF cycle time shall be sufficient to ensure all outputs bleed down.

e. Procedure.

(1) Pull up EFTS GUI (Figure 3).

(2) Click “Receiver Power On”.

(3) Click “Set” button.

(4) Close switch #500.

(5) Switch “UNLATCH” on then off (Portable EFTS Transmitter System (PETS)).

(6) Switch “Clear Command Count” (CCC) on then off (PETS).

(7) Verify current draw is greater than 40 mA.

(8) Click “Optional” button (GUI).

(9) Select Recall #8 on oscilloscope.

(10) Set Switcher to 100 and press open.

(11) Press close.

(12) Look for transients on oscilloscope.

(a) If oscilloscope is triggered:

1 Record amplitude and pulse width (ch #1).

2 Reset oscilloscope.

(b) If oscilloscope is NOT triggered, continue to step #13.

(13) Repeat steps 10 through 12 twenty-five times.

(14) Click “Disconnect All” button. If no transients are seen, write PASS on datasheet for corresponding command.

(15) Repeat steps #8 - #14 for the following commands:

(a) Monitor.

(b) Arm.

(c) Terminate.

(16) Transmit the MONITOR, OPTIONAL, ARM, TERMINATE, and COMMAND UNLATCH commands. Verify normal outputs.

f. Pass/Fail Criteria. The EFTR will not be damaged by the momentary interruption in DC power. Any transient responses generated will meet the EFTR specification for amplitude and pulse width into the required loads.

5.4 Abnormal Voltage (Test Number 4).

a. Purpose. This test verifies that the EFTR can survive voltages outside the guaranteed operating ranges. The most common cause of abnormal voltages to an EFTR is from the battery voltage decreasing at the end of its life.

b. Requirement. The EFTR shall not produce an inadvertent output or be damaged by momentary interruptions or fluctuation in the input power between 0.0 VDC and nominal voltage.

c. Test Equipment Requirements. The DC power supply must have the capability of adjustment from 0 to nominal voltage in minimum step resolutions of 1 V.

d. Setup. Connect the UUT to the test equipment as shown in Appendix A and Table 7.

TABLE 7. TEST SETUP FOR ABNORMAL VOLTAGE

DEVICE	SETTINGS
RF Generator	
Power Output	-107 dBm
Frequency	F_o
Deviation	± 50 kHz
Modulation	On
UUT Configuration	
Configuration Location	0
Transmitter ID (TXID)	2
Range ID (RID)	1
Vehicle ID (VID)	11
Command Counter (CC)	0
Failsafe	Off
Power Supply	
Voltage	The voltage will be varied from 0 volts to nominal voltage, and back to 0 volts.

e. Procedure.

(1) Pull up EFTS GUI (Figure 3).

(2) Click “Receiver Power On”.

(3) Set “PS 1 Voltage” to 28 V.

(4) Close switch #500.

(5) Switch “UNLATCH” on then off (PETS).

(6) Switch “CCC” on then off (PETS).

(7) Verify current draw is greater than 40 mA.

(8) Send MONITOR command.

(9) Drop MONITOR command.

(10) Set “PS 1 Voltage” to 0 V (GUI).

(11) Send a “NO-OP” command.

(12) Click “Volt incr by 1” button, to increment voltage up to 28 V (GUI).

(13) Click “Volt dec by 1” button, to decrement voltage down to 0 V (GUI).

(14) Set “PS 1 Voltage” to 28 V (GUI).

(15) Transmit the MONITOR, OPTIONAL, ARM, TERMINATE, and COMMAND UNLATCH commands. Verify normal outputs.

(16) Click “Disconnect All” button.

e. Pass/Fail Criteria. All outputs will remain OFF during the voltage changes and the EFTR will respond properly to the standard logic commands afterwards.

5.5 Maximum Usable RF Level/Dynamic Range (Test Number 5).

a. Purpose. This test verifies that the EFTR can operate with varying RF inputs from the minimum specified level, up to and including high levels of RF. A high level for this purpose is +13 dBm (1 Vrms) of RF.

b. Requirement. The EFTR shall meet all specified requirements while receiving an EFTS signal from less than or equal to -107 dBm, up to +13 dBm, as measured at the RF input.

c. Test Equipment Requirements. A counter or other method to verify the difference between the number of commands sent and received.

d. Setup. Connect the UUT to the test equipment as shown in Appendix B and Table 8.

TABLE 8. TEST SETUP FOR MAXIMUM USABLE RF LEVEL/DYNAMIC RANGE

DEVICE	SETTINGS
RF Generator	
Power Output	+13, -7, -27, -47, -67, and -107 dBm
Frequency	F_o
Deviation	± 50 kHz
UUT Configuration	
Configuration Location	0
Transmitter ID (TXID)	2
Range ID (RID)	1
Vehicle ID (VID)	11
Command Counter (CC)	0
Failsafe	Off
Power Supply	
Voltage	28 V

e. Procedure.

(1) Connect “Trigger Out” (PETS) to Channel 2 (oscilloscope).

(2) Pull up EFTS GUI (Figure 3).

(3) Click “Receiver Power On” (GUI).

(4) Set “PS 1 Voltage” to 28 V.

(5) Close switch #500.

(6) Switch UNLATCH command on then off.

(7) Switch CCC command on then off.

(8) Verify current draw is greater than 40 mA.

(9) Set Signal Generator to +13 dBm.

(10) Switch CHECK CHANNEL command on.

(11) Click “Monitor” button (GUI).

(12) Select “Recall #9” on oscilloscope.

(13) Set oscilloscope to run.

(14) Send MONITOR command.

(15) Run for two seconds.

(16) Verify all commands are properly decoded.

(17) Repeat steps 10 and 11 for the following Signal Generator levels:

(a) -107 dBm.

(b) -7 dBm.

(c) -67 dBm.

(d) -27 dBm.

(e) -47 dBm.

(18) Click “Disconnect All” button.

f. Pass/Fail Criteria. The EFTR will process all the commands properly and will not have any undesired output, either on a monitor or command output channel.

5.6 RF Threshold Sensitivity (Test Number 6).

a. Purpose. This test verifies that the EFTR threshold sensitivity meets the minimum specified in the procurement specification, at the required MER. This test will measure the as-built absolute minimum (lowest possible) RF level where the EFTR will continue to properly perform its intended function.

b. Requirement. The minimum RF signal input level and MER, at which the EFTR correctly responds, will be as specified in the procurement specification and will be less than or equal to -107 dBm at a MER of 1x10-4 (1 message error per 10,000 messages).

c. Test Equipment Requirements. The RF generator must have an RF output amplitude that can be varied (from at least -127 to -87 dBm), and with a worst-case resolution of 1 dB and a minimum accuracy of ± 0.5 dB.

d. Setup. Connect the UUT to the test equipment as shown in Appendix A and Table 9.

TABLE 9. TEST SETUP FOR THE RF THRESHOLD SENSITIVITY

DEVICE	SETTINGS
RF Generator	
Power Output	Varied from -127 dBm, in 1 dB increments to where the MER is $1x10^{-2}$
Frequency	F_o
Deviation	± 50 kHz
Modulation	On
UUT Configuration	
Configuration Location	0
Transmitter ID (TXID)	2
Range ID (RID)	1
Vehicle ID (VID)	11
Command Counter (CC)	0
Failsafe	Off
Power Supply	
Voltage	22 V, 28 V, and 36 V

NOTE: To reduce test time, the RF sensitivity is determined at a MER of $1x10^{-2}$, and then the MER of $1x10^{-4}$ is verified at -107 dBm

e. Procedure.

(1) Pull up EFTS GUI (Figure 3).

(2) Click “Receiver Power On”.

(3) Set the DC power supply to 22 V.

(4) Set the RF signal level to -127 dBm.

(5) Send CHECK CHANNEL command.

(6) Send MONITOR command.

(7) Press “Monitor” on oscilloscope.

(8) Select “Recall #9” on oscilloscope.

(9) Set oscilloscope to run.

(10) Wait 2 seconds to see if oscilloscope triggers.

(a) If oscilloscope triggered:

1 Set RF 1 dBm up.

2 Repeat steps 7 through 10.

(b) If oscilloscope is not triggered, record the RF level in dBm for a MER of $1x10^{-2}$ as the "measured RF threshold sensitivity".

(11) Drop MONITOR command.

(12) Set the RF signal level to -107 dBm.

(13) Click "Check Channel" button.

(14) Select "Recall #10" on oscilloscope.

(15) Set oscilloscope to run.

(16) Send ARM command.

(17) Wait a minimum of 3 minutes and 20seconds:

(a) If oscilloscope triggered, record time it took to trigger.

(b) If oscilloscope is not triggered, record as passed.

(18) Verify the number of missed messages is not greater than 1 (MER of $1x10^{-4}$).

(19) Set the DC power supply to 28 V.

(20) Repeat steps 3 through 18.

(21) Set the DC power supply to 36 V.

(22) Repeat steps 3 through 18.

f. Pass/Fail Criteria. The EFTR measured threshold sensitivity will meet the procurement specification and be -107 dBm or less at a MER of $1x10^{-2}$ and $1x10^{-4}$.

5.7 Command Interface Requirements Document (IRD) Verification (Test Number 7).

a. Purpose. This test verifies that the EFTR operates properly according to the EFTS IRD at the minimum specified RF level.

b. Requirement. The EFTR will respond to all messages and functions according to the EFTS IRD at the minimum specified RF threshold level.

c. Test Equipment Requirements. All EFTR command outputs and telemetry monitoring outputs must be continuously monitored during this test.

d. Setup. Connect the UUT to the test equipment as shown in Appendix A and Table 10.

TABLE 10. SENSITIVITY TEST SETUP FOR COMMAND IRD VERIFICATION

DEVICE	SETTINGS
RF Generator	
Power Output	-107 dBm
Frequency	F_o
Deviation	± 50 kHz
Modulation	On
UUT Configuration	
Configuration Location	01, 10, 11
Transmitter ID (TXID)	Varies
Range ID (RID)	Varies
Vehicle ID (VID)	Varies
Command Counter (CC)	Varies
Failsafe	Off
Power Supply	
Voltage	Minimum, nominal, and maximum specified voltages

e. Procedure.

(1) Load the configurations in Table 11 into the EFTR, and set Configuration ID 10 as the active configuration.

TABLE 11. CONFIGURATIONS FOR COMMAND IRD VERIFICATION

CONFIGURATION ID	RANGE ID	VEHICLE ID	COMMAND COUNTER	TRANSMITTER ID
01	1	1	ON	1
10	1	1	ON	1, 30
11	2	1	OFF	1

(2) Pull up EFTS GUI (Figure 3).

(3) Click “Receiver Power On”.

(4) Set the DC power supply to 22 V.

(5) Set the RF amplitude to -107 dBm.

(6) Apply each step in Table 12.

(7) Verify that the EFTR decodes the commands correctly and has only normal command and monitor outputs in accordance with Table 12.

(8) Set the DC power supply to 28 V.

(9) Repeat step 5 through 7.

(10) Set the DC power supply to 36 V.

(11) Repeat step 5 through 7.

TABLE 12. EFTR IRD LOGIC

STEP	COMMAND	RID	TXID	VID	CC	USER DATA	CHECK CHANNEL	ACTIVE OUTPUTS[a]
1	No-Op	1	1	1	1	7	Off	V
2	Monitor	1	1	1	2	7	Off	V,M
3	No-Op	1	1	1	3	7	Off	V
4	Optional	1	1	1	4	7	Off	V, O
5	No-Op	1	1	1	5	7	Off	V, O
6	Cmd Unlatch	1	1	1	6	7	Off	V
7	Arm	1	1	1	7	7	Off	V, A
8	Terminate	1	1	1	8	7	Off	V, A, T
9	No-Op	1	1	1	9	7	Off	V, A, T
10	Cmd Unlatch	1	1	1	10	7	Off	V
11	Monitor	1	1	1	11	7	Off	V, M
12	Optional	1	1	1	12	7	Off	V, O
13	Arm	1	1	1	13	7	Off	V, O, A
14	Terminate	1	1	1	14	7	Off	V, O, A, T
15	No-Op	1	1	1	15	7	Off	V, O, A, T
16	Cmd Unlatch	1	1	1	16	7	Off	V
17	Terminate	1	1	1	17	7	Off	--
18	Cmd Unlatch	1	1	1	18	7	Off	V

TABLE 12. CONTINUED

STEP	COMMAND	RID	TXID	VID	CC	USER DATA	CHECK CHANNEL	ACTIVE OUTPUTS[a]
19	Arm	1	1	1	19	7	Off	V, A
20	Cmd Unlatch	1	1	1	20	7	Off	V
21	Terminate	1	1	1	21	7	Off	--
22	Cmd Unlatch	1	1	1	22	7	Off	V
23	Arm	1	1	1	23	7	Off	V, A
24	Optional	1	1	1	24	7	Off	V, A, O
25	Terminate	1	1	1	25	7	Off	V, A, O, T
26	Cmd Unlatch	1	1	1	26	7	Off	V
27	Arm	1	1	2	27	7	Off	--
28	Terminate	1	1	1	28	7	Off	--
29	Cmd Unlatch	1	1	1	29	7	Off	V
30	Arm	1	2	1	30	7	Off	--
31	Terminate	1	1	1	30	7	Off	--
32	Cmd Unlatch	1	1	1	30	7	Off	V
33	Terminate	1	1	1	32	7	Off	--
34	Arm	1	1	1	31	7	Off	V, A
35	Terminate	1	1	1	33	7	Off	V, A, T
36	Cmd Unlatch	1	1	1	34	7	Off	V
37	Monitor	1	1	1	60	7	Off	V, M
38	Optional	1	1	1	40	7	Off	--
39	Optional	1	1	1	61	7	Off	V, O
40	Monitor	1	1	1	62	7	Off	V, O
41	Cmd Unlatch	1	1	1	63	7	Off	V
42	Clear Counter	1	1	1	64	7	Off	V
43	Monitor	1	1	1	1	7	Off	V, M
44	Cmd Unlatch	1	1	1	2	11	Off	V
45	Wireless Commit	1	1	1	3	11	Off	V
46	Cmd Unlatch	1	1	1	4	11	Off	V
47	Wireless Commit	1	1	1	5	11	Off	--
48	Optional	1	1	1	1	11	Off	V, O
49	Cmd Unlatch	1	1	1	6	11	Off	V
50	Wireless Enable	1	1	1	7	11	Off	V
51	Wireless Commit	1	1	1	8	11	Off	V[b]
52	Optional	2	1	1	1	11	Off	V, O
53	No-Op	2	1	1	1	11	Off	V, O
54	Cmd Unlatch	2	1	1	1	10	Off	V
55	Wireless Enable	2	1	1	1	10	Off	V
56	Wireless Commit	2	1	1	1	10	Off	V[b]
57	Optional	1	1	1	1	10	Off	V, O

TABLE 12. CONTINUED

STEP	COMMAND	RID	TXID	VID	CC	USER DATA	CHECK CHANNEL	ACTIVE OUTPUTS[a]
58	Optional	1	1	2	0	10	On	C, O
59	Optional	1	2	2	0	10	On	O
60	Cmd Unlatch	1	1	1	2	10	Off	V
61	Monitor	1	1	1	9	10	On	V, M, C
62	Optional	1	1	1	10	10	On	V, O, C
63	Arm	1	1	1	11	10	On	V, O, A, C
64	Terminate	1	1	1	12	10	On	V, O, A, T, C
65	Monitor	1	1	1	13	13	On	V, M, O, A, T, C
66	Cmd Unlatch	1	1	1	14	13	Off	V
67	Wireless Enable	1	1	1	15	13	Off	V
68	Optional	1	1	1	16	13	On	V, O, C
69	Wireless Commit	1	1	1	17	13	Off	O
70	Monitor	1	1	5	18	13	Off	O
71	Cmd Unlatch	1	1	1	19	13	On	V, C
72	Wireless Enable	1	1	1	20	13	Off	V
73	Wireless Commit	1	1	1	22	13	Off	--
74	Wireless Commit	1	1	1	23	13	Off	-
75	Monitor	1	5	1	25	13	Off	--
76	Cmd Unlatch	1	1	1	200	13	On	V, C
77	Clear Counter	1	1	1	10	13	On	V, C
78	Monitor	1	1	1	15	13	On	V, M, C
79	Optional	1	1	1	20	13	On	V, O, C
80	Arm	1	1	1	21	13	On	V, O, A, C
81	No-Op	1	1	1	25	13	On	V, O, A, C
82	Terminate	1	1	1	30	13	On	V, O, A, T, C
83	Cmd Unlatch	1	1	1	32	13	On	V, C
84	Fail-Safe Enable	1	1	1	40	5	On	V, C, FSE, FSO
85	Fail-Safe Disable	1	1	1	40	5	Off	V
86	No-Op	1	1	1	40	10	On	V, C
87	Monitor	1	1	1	40	10	Off	V, M
88	Optional	2	1	1	40	10	On	--
89	Optional	1	1	1	40	10	On	V, O, C
90	Arm	1	1	1	40	10	Off	V, O, A
91	Terminate	1	1	1	40	10	On	V, O, A, T, C
92	Cmd Unlatch	1	1	1	40	10	Off	V
93	Fail-Safe Enable	1	1	1	40	10	On	V, C, FSE, FSO
94	Fail-Safe Disable	1	1	1	40	10	Off	V
95	No-Op	1	1	30	10	10	Off	V
96	Wireless Enable	1	1	1	40	10	Off	V

TABLE 12. CONTINUED

STEP	COMMAND	RID	TXID	VID	CC	USER DATA	CHECK CHANNEL	ACTIVE OUTPUTS[a]
97	Wireless Commit	1	1	1	40	10	Off	V[b]
98	No-Op	1	1	1	1	10	Off	V
99	No-Op	1	1	30	1	10	Off	V
100	No-Op	1	1	30	10	10	Off	V
101	CC Clear	1	1	1	2	11	Off	--
102	No-Op	1	1	1	1	11	On	V, C
103	No-Op	1	1	30	1	11	On	V
104	No-Op	1	1	1	1023	11	Off	V
105	Monitor	1	1	1	1023	11	Off	V, M
106	Optional	1	1	1	1023	11	On	V, O, C
107	Arm	1	1	1	1023	11	Off	V, O, A
108	Terminate	1	1	1	1023	11	On	V, O, A, T, C
109	Cmd Unlatch	1	1	1	1023	11	Off	V
110	Fail-Safe Enable	1	1	1	1023	11	On	V, C, FSE, FSO
111	Fail-Safe Disable	1	1	1	1023	11	Off	V
112	Wireless Enable	1	1	1	1023	1	Off	V
113	Wireless Commit	1	1	1	1023	1	Off	V
114	No-Op	1	1	1	1	1	Off	V
115	Wireless Commit	1	30	1	2	1	Off	--
116	No-Op	1	1	1	2	33	Off	V, Validate User Serial Output=33
117	Wireless Enable	1	1	1	1	1	Off	V, Validate User Serial Output is Mute during receipt of WE
118	Wireless Commit	1	1	1	1	1	Off	V, Validate User Serial Output is Mute during receipt of WC
119	No-Op	1	1	1	1	22	Off	V, Validate User Serial Output=
120	Wireless Enable	1	1	1	1	56	Off	--
121	Wireless Commit	1	1	1	1	56	Off	--

NOTES: [a] A=Arm, C= Check, M=Monitor, O=Optional, T=Terminate, V= Command Valid, FSE= Failsafe Telemetry (TLM), FSO= Failsafe Output.

[b] Command valid output on for only 20 milliseconds and then off.

f. Pass/Fail Criteria. The EFTR will process the commands properly and will not have any undesired output, either on a monitor or command output channel, when operated into the specified load.

5.8 Acquisition/Reacquisition Time (Test Number 8).

a. Purpose. This test measures the amount of time it requires for the receiver to acquire and lockup to a message when it first appears, due to switching transmitters or varying the RF level.

b. Requirement. Upon initial RF reception, the measured acquisition time shall not be greater than 60 milliseconds for 95% of the samples and shall never exceed 100 milliseconds within the RF dynamic range of the receiver.

c. Test Equipment Requirements. The time interval measurement instrument must be capable of a measurement display resolution of at least 0.1 milliseconds and a minimum accuracy of 0.05 milliseconds.

d. Setup. Connect the UUT to the test equipment as shown in Appendix C and Table 13.

TABLE 13. TEST SETUP FOR ACQUISITION/REACQUISITION TIME

DEVICE	SETTINGS
RF Generator	
Power Output	-107 dBm pulsed at a rate of 250 milliseconds on and 500 milliseconds off
Frequency	F_o
Deviation	± 50 kHz
UUT Configuration	
Configuration Location	0
Transmitter ID (TXID)	2
Range ID (RID)	1
Vehicle ID (VID)	11
Command Counter (CC)	0
Failsafe	Off
Power Supply	
Voltage	28 V

NOTE: The acquisition time is the time required for the EFTR to activate a channel output after a command signal is applied to the RF input. When performing the measurement, the signal generator RF output settling time needs to be taken into account. The messages are continually being applied to the RF signal generator and are not synchronized with the application of the RF.

e. Procedure.

(1) Pull up EFTS GUI (Figure 3).

(2) Click “Receiver Power On”.

(3) Hook up the break out box to the EFTR.

(4) Connect cable from pins 2 and 3 of the break out box to channel 2 of the oscilloscope.

(5) Select “Recall #11” on oscilloscope.

(6) Click “Monitor” button.

(7) Send MONITOR command.

(8) Set oscilloscope to run.

(9) Turn RF power on (-107 dBm) (Figure 4).

(10) Use oscilloscope to measure the time between RF on and command sent.

(11) Record time on data sheet.

(12) Repeat steps 8 through 11 twenty times.

(13) Record the number of times the acquisition time exceeds 60 milliseconds, the maximum response time, and the average response time.

f. Pass/Fail Criteria. The average acquisition time will be less than or equal to 60 milliseconds, the worst case acquisition time will be less than or equal to 100 milliseconds, and only one acquisition time measurement during the 20 cycles can exceed 60 milliseconds (95%).

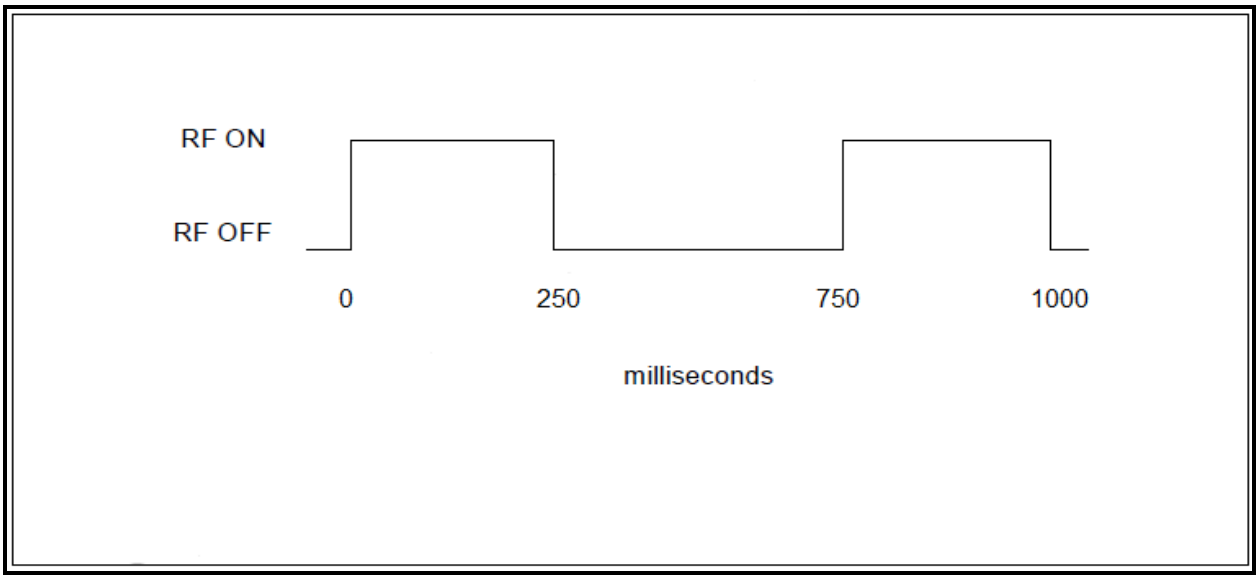

Figure 4. RF output timing.

5.9 Inverted Modulation (Test Number 9).

a. Purpose. This test verifies that the EFTR can properly decode messages that have their modulation inverted by the transmitter.

b. Requirement. The EFTR shall detect and compensate for signals that are inverted at the transmitter (i.e. a positive voltage generating a **negative** frequency offset and a negative voltage generating a **positive** frequency offset).

c. Test Equipment Requirements. A method to invert the modulation into the RF signal generator is required.

d. Setup. Connect the UUT to the test equipment as shown in Appendix D and Table 14.

e. Procedure.

(1) Power on all equipment.

(a) Computer.

(b) EFTS-600 Encoder.

(c) Signal Generator.

(d) EFTC (EFTS FTR Test Case).

TABLE 14. TEST SETUP FOR INVERTED MODULATION

DEVICE	SETTINGS
RF Generator	
Power Output	-95 dBm
Frequency	F_o
Deviation	± 50 kHz
UUT Configuration	
Configuration Location	0
Transmitter ID (TXID)	2
Range ID (RID)	1
Vehicle ID (VID)	11
Command Counter (CC)	0
Failsafe	Off
Power Supply	
Voltage	28 V

(2) Open/Run LabView VI “EFTS Encoder.vi”.

(3) Click on Settings tab and ensure the following:

(a) Configuration and Status Interference (CSI) port is set to “COM3”.

(b) CSI baud rate is set to “19200”.

(c) Command Control Interface (CCI) port is set to “COM4”.

(d) CCI baud rate is set to “57600”.

(4) Click on the CSI tab.

(5) Click the “Request Key Status” button.

(6) Verify “Cyclic Redundancy Check (CRC) Valid” light is green and Key is loaded.

(7) Click “Request Config”.

(8) Verify “CRC Valid” light is green.

(9) Under the “Set Config” control section, set “Polarity” to Positive.

(10) Click “Set Config”.

(11) Click “Set CW Mode”.

(12) Click on the CCI Tab.

(13) Verify “Auto Send” toggle is set to On.

(14) Verify RID, TXID, and VID are all set to match EFTR settings.

(15) Turn RF on (-95 dBm).

(16) Click on “Optional”.

(17) Verify EFTC received command.

(18) Click on “Monitor”.

(19) Verify EFTC received command.

(20) Click on “Arm”.

(21) Verify EFTC received command.

(22) Click on “Terminate”.

(23) Verify EFTC received command.

(24) Click on “Default”.

(25) Verify EFTC clears all commands.

(26) Click on “Clear Command (CMD) Counter”.

(27) Click on the CSI Tab.

(28) Under the “Set Config” control section, set “Polarity” to Negative.

(29) Click “Set Config”.

(30) Click on the CCI Tab.

(31) Repeat steps 16 through 26.

(32) Click the stop symbol on LabView.

(33) Power down all equipment.

f. Pass/Fail Criteria. All command outputs and monitor outputs shall respond properly.

5.10 Signal Strength Telemetry Output (SSTO) (Test Number 10).

a. Purpose. This test verifies that the signal strength telemetry output (SSTO) voltage is monotonic and directly related to the RF carrier signal level. This test also measures, records, and graphs an SSTO curve (see Figure 5).

b. Requirement. When operating into a 10k-ohm load the SSTO will meet the following requirements:

(1) The SSTO output level at quiescent (no RF) shall be 0.5 ± 0.25 VDC.

(2) The SSTO measured command threshold sensitivity input condition shall be 0.1 VDC minimum above the quiescent value.

(3) The SSTO output level shall be 4.50 VDC or less at -60 dBm, and at least 4.50 VDC at -50 dBm of RF input.

(4) The shape of the transfer function will not exceed approximately 1.0 VDC change in voltage for each 13 dB change in RF input signal over the range between threshold and saturation.

(5) The maximum SSTO voltage shall not exceed 5 VDC under all conditions.

(6) The slope of the SSTO voltage shall not change polarity from measured threshold to +13 dBm with no more than a 50 millivolt drop after saturation has been reached.

c. Test Equipment Requirements. The RF signal generator must have an RF amplitude resolution of 1 dB and an accuracy of at least 0.5 dB. The SSTO reading voltmeter must have a minimum resolution of 4½ digits and have an accuracy of at least one percent.

d. Setup. Connect the UUT to the test equipment as shown in Appendix A and Table 15.

e. Procedure. Run Test # 7 on the automated tester.

f. Pass/Fail Criteria. The SSTO output voltage shall meet the following requirements:

(1) The quiescent (no RF signal) condition shall be 0.5 ± 0.25 VDC.

(2) The SSTO at the guaranteed TERMINATE threshold sensitivity shall be a minimum of VDC above the quiescent value.

(3) The SSTO voltage shall be 4.5 VDC, or less at -60 dBm, and at least 4.50 VDC at -50 dBm.

(4) The SSTO shall not exceed 5 VDC under all conditions.

(5) The slope of the SSTO voltage shall not change polarity from -107 dBm to +13 dBm, and shall have no more than a 50 millivolt drop after saturation has been reached.

TABLE 15. TEST SETUP FOR SSTO

Device	Settings
RF Generator	
Power Output	Off and -120 dBm (increasing to +13 dBm)
Frequency	F_o
Deviation	± 50 kHz
UUT Configuration	
Configuration Location	0
Transmitter ID (TXID)	2
Range ID (RID)	1
Vehicle ID (VID)	11
Command Counter (CC)	0
Failsafe	Off
Power Supply	
Voltage	28 V

g. Figure 5 shows an example of a typical SSTO monitor curve.

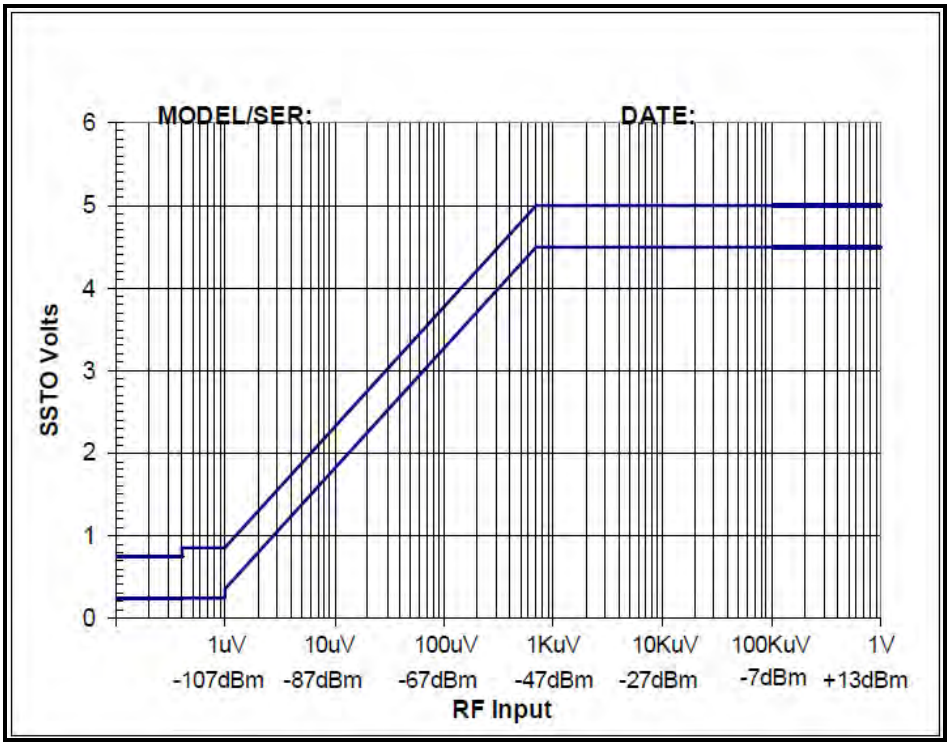

Figure 5. Typical SSTO monitor curve.

5.11 Operational Bandwidth (Test Number 11).

a. Purpose. This test verifies that the EFTR is capable of properly operating across a specified bandwidth. The operational bandwidth requirements are a direct result of instability in the EFTR local oscillator, redetection instability, command transmitter instabilities, and Doppler effects of the RF uplink.

b. Requirement. The EFTR shall properly decode commands within the specified bandwidth, or ± 35 kHz, from the assigned RF center frequency.

c. Test Equipment Requirements. The RF signal generator output must be variable in RF amplitude in 0.1 dB increments, with at least 0.5 dB accuracy, and RF frequency in 1 kHz increments with at least 100 hertz (Hz) accuracy.

d. Setup. Connect the UUT to the test equipment as shown in Appendix B and Table 16.

TABLE 16. TEST SETUP FOR OPERATIONAL BANDWIDTH

DEVICE	SETTINGS
RF Generator	
Power Output	-107 dBm
Frequency	F_o varied at least ± 35 kHz from center frequency
Deviation	± 50 kHz
UUT Configuration	
Configuration Location	0
Transmitter ID (TXID)	2
Range ID (RID)	1
Vehicle ID (VID)	11
Command Counter (CC)	0
Failsafe	Off
Power Supply	
Voltage	28 V

e. Procedure.

(1) Set the RF level to -107 dBm.

(2) Send MONITOR command.

(3) Send CHECK CHANNEL command.

(4) Click “Monitor” (GUI).

(5) Select “Recall #11” on oscilloscope.

(6) Select Mode->Auto on oscilloscope.

(7) Click “Freq down 1 kHz” button (GUI).

(8) Verify oscilloscope has no drop outs.

(a) If NO dropouts occur, repeat steps 7 and 8.

(b) If dropouts do occur, click “Freq up 1 kHz” until oscilloscope display is back and stable.

(9) Record the frequency where the oscilloscope is stable, as the lower operation bandwidth frequency.

(10) Set the Frequency to 425 MHz.

(11) Click “Freq up 1 kHz” button (GUI).

(12) Verify oscilloscope has no drop outs.

(a) If NO dropouts occur, repeat steps 7 and 8.

(b) If dropouts do occur, click “Freq down 1 kHz” until oscilloscope display is back and stable.

(13) Record the frequency where the oscilloscope is stable, as the “upper operation bandwidth frequency”.

(14) Click the “Disconnect All” button.

f. Pass/Fail Criteria. Commands shall have a minimum operational bandwidth of ± 35 kHz.

5.12 Continuous Wave (CW) Bandwidth (Test Number 12).

a. Purpose. This test verifies that the EFTR's pass band is narrow enough to reject unwanted signals and is centered on the assigned RF center frequency.

b. Requirement. The CW bandwidth shall be ± 180 kHz maximum at the 55-dB points and ± 275 kHz maximum at the 60-dB points.

c. Test Equipment Requirements. The RF signal generator output must be variable in RF amplitude in 0.1 dB increments, with at least 0.5 dB accuracy, and RF frequency in 1 kHz

increments with at least 100 Hz accuracy. The voltmeter used to measure the SSTO must have at least 4½ digits and have a minimum accuracy of one percent.

d. Setup. Connect the UUT to the test equipment as shown in Appendix A and Table 17.

TABLE 17. TEST SETUP FOR CW BANDWIDTH

DEVICE	SETTINGS
RF Generator	
Power Output	Specified minimum threshold sensitivity with 55 and 60 dB output increases
Frequency	F_o varied from center frequency
Deviation	± 50 kHz
UUT Configuration	
Configuration Location	0
Transmitter ID (TXID)	2
Range ID (RID)	1
Vehicle ID (VID)	11
Command Counter (CC)	0
Failsafe	Off
Power Supply	
Voltage	28 V

e. Procedure. Run Test # 10 on the automated tester, but change dB level from -3 dB to -55 dB.

f. Pass/Fail Criteria. The EFTR's measured CW bandwidth shall be no greater than ± 180 kHz at the 55 dB bandwidth, and no greater than ± 275 kHz at the 60 dB bandwidth. The calculated center frequency of the 60 dB bandwidth will be within ± 0.005% of the assigned center frequency.

5.13 CW Peak-to-Valley Ratio (Test Number 13).

a. Purpose. This test measures and verifies that the flatness of the intermediate frequency (IF) filter assembly is as specified.

b. Requirement. The threshold sensitivity of the EFTR shall not vary more than 3 dB across the specified operational bandwidth of ± 35 kHz.

c. Test Equipment Requirements. The RF signal generator’s RF amplitude must be variable in 0.1 dB increments, with at least 0.5 dB accuracy, and the carrier frequency must be

variable in 1 kHz increments with at least 100 Hz accuracy. The voltmeter used to measure the SSTO must have at least 4½ digits and have a minimum accuracy of one percent.

d. Setup. Connect the UUT to the test equipment as shown in Appendix A and Table 18.

TABLE 18. TEST SETUP FOR CW PEAK-TO-VALLEY

DEVICE	SETTINGS
RF Generator	
Power Output	Specified minimum threshold sensitivity level (varied above and below)
Frequency	F_o varied from center frequency ± 35 kHz
Deviation	Off
UUT Configuration	
Configuration Location	0
Transmitter ID (TXID)	2
Range ID (RID)	1
Vehicle ID (VID)	11
Command Counter (CC)	0
Failsafe	Off
Power Supply	
Voltage	28 V

e. Procedure. Run Test # 10 on the automated tester, but change dB level from -3 dB to -55 dB.

f. Pass/Fail Criteria. The measured peak-to-valley ratio will be equal to or less than 3 dB. A typical peak-to-valley ratio curve is shown in Figure 6.

5.14 Self -Test (Test Number 14).

a. Purpose. This test verifies that the EFTR is operating correctly as defined by the built-in self-test diagnostic routines. The failure of self-test will indicate that the EFTR is either not operating properly, or its memory has failed.

b. Requirement. The EFTR shall perform a self test upon application of power, or on receiving a SELF TEST command, and issue a pass/fail output. The execution of a self-test shall not inhibit the processing of a command or cause a command output to change state. The failure of a self test shall not disable the receiver.

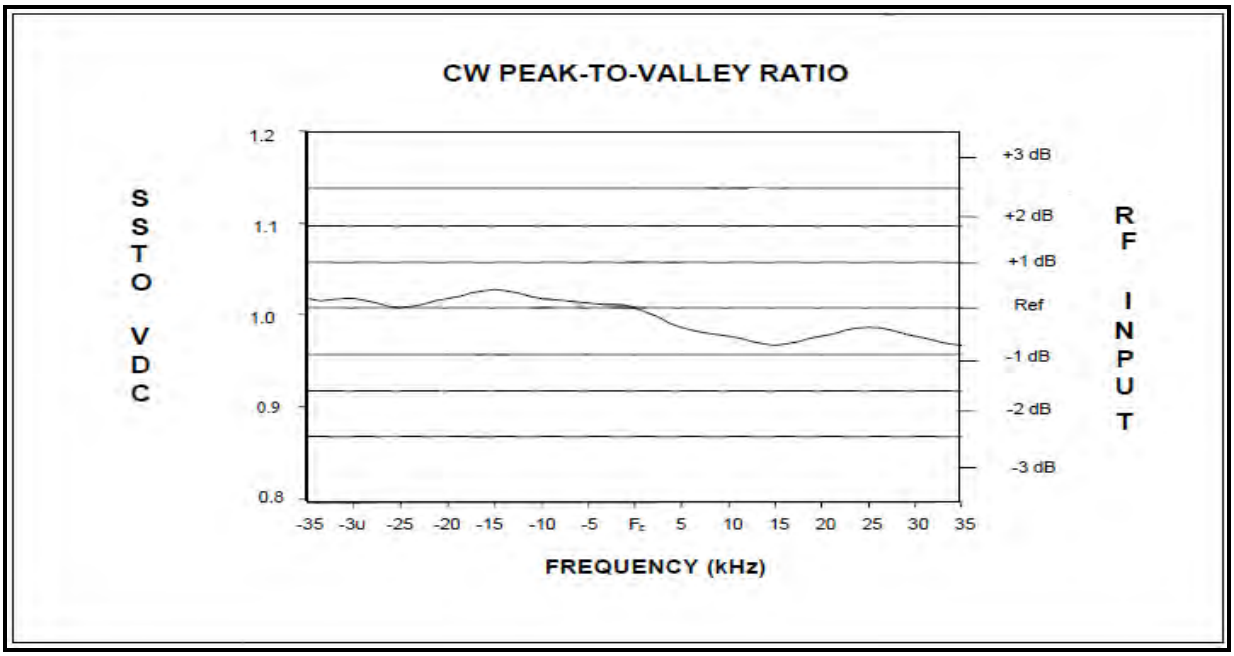

Figure 6. Typical peak-to-valley ratio curve.

c. Test Equipment Requirements. No special requirements.

d. Setup. Connect the UUT to the test equipment as shown in Appendix A and Table 19.

TABLE 19. TEST SETUP FOR SELF TEST

DEVICE	SETTINGS
RF Generator	
Power Output	-107 dBm
Frequency	F_o
Deviation	± 50 kHz
Modulation	On
UUT Configuration	
Configuration Location	0
Transmitter ID (TXID)	2
Range ID (RID)	1
Vehicle ID (VID)	11
Command Counter (CC)	0
Failsafe	Off
Power Supply	
Voltage	The voltage will be switched between off and 28

e. Procedure.

(1) Turn Signal Generator RF off.

(2) Pull up EFTS GUI (Figure 3).

(3) Click “Receiver Power On”. Powering the receiver on will automatically initiate a power-on self-test.

(4) Monitor the “Receiver stat tlm out” for 1 V, signifying the UUT has passed the self-test and the command outputs remain OFF.

(5) Leave the receiver powered on.

(6) Turn on the RF to -107 dBm

(7) Send Test (TST) command.

(8) Monitor the “Receiver stat tlm out” for 0.5 V, signifying the self-test is complete and the results are satisfactory.

(9) Drop TST command.

(10) Send TST command and immediately send an ARM command.

(11) Verify the UUT processes the ARM command, passes the self-test, and does not change the state of the ARM command after completion of the self-test.

(12) Drop TST command.

(13) Send TST command and immediately send an TERMINATE command.

(14) Verify the TERMINATE command is processed, the ARM output stays ON, the self-test passes, and the TERMINATE and ARM states do not change after completion of the self-test.

f. Pass/Fail Criteria. The EFTR will process the SELF-TEST command properly, and running the self-test will not prohibit the processing of the ARM and TERMINATE commands or cause the command outputs to change state.

5.15 Receiver Status Telemetry Output (RSTO) (Test Number 15).

a. Purpose. This test verifies the RSTO output varies its voltage level to indicate the current state of the vehicle and the Receiver/Decoder’s microprocessor is operating correctly, as defined by the built-in self-test diagnostic routines. This test also verifies the correct telemetry voltages are present while in the on or off state.

b. Requirement. The voltage on the EFTR's RSTO output shall show the status of the receiver and the results of a self-test, as shown in Table 20.

TABLE 20. RSTO OUTPUT VOLTAGE LEVELS

STATE	DC VOLTAGE	NOTES
Running Self Test	.5 ± 0.1 VDC	Running Self Test (20 milliseconds after receiving any test CMD)
Passed Self Test	1.0 ± 0.1 VDC	Passed Self Test
Bit Synch Sequence	1.5 ± 0.1 VDC	Bit Synch is locked
Frame Synch Lock Sequence	2.0 ± 0.1 VDC	Frame Synch is locked
RID Valid Sequence	2.5 ± 0.1 VDC	Field contains valid RID
TXID Valid Sequence	3.0 ± 0.1 VDC	Field contains valid TXID
VID Valid Sequence	3.5 ± 0.1 VDC	Field contains valid VID
Command Valid Sequence	4.0 ± 0 1 VDC	Field contains valid Command
Command Accepted Sequence	4.5 ± 0.1 VDC	Command has been accepted and Counter authentication valid

c. Test Equipment Requirements. The command message encoder must have the capability to generate a 7.2 kHz, 50% duty cycle square wave as well as the usual EFTS messages. The voltmeter used to measure the RSTO must have at least 4½ digits and have a fast enough response time to measure the RSTO voltage during the time the EFTR is actually running the self-test to an accuracy of one percent.

d. Setup. Connect the UUT to the test equipment as shown in Appendix A and Table 21.

TABLE 21. TEST SETUP FOR RSTO

DEVICE	SETTINGS
RF Generator	
Power Output	-107 dBm
Frequency	F_o
Deviation	± 50 kHz
UUT Configuration	
Configuration Location	0
Transmitter ID (TXID)	2
Range ID (RID)	1
Vehicle ID (VID)	11
Command Counter (CC)	0
Failsafe	Off
Power Supply	
Voltage	28 V

e. Procedure.

(1) Apply the specified load to the RSTO output and do not apply any RF to the UUT.

(2) Pull up EFTS GUI (Figure 3).

(3) Turn RF On.

(4) Click the “Receiver Power On” button and immediately read the RSTO output voltage. Record the voltage during the power-up self test as the “running self-test voltage”.

(5) Upon completion of the self-test, read the RSTO output voltage. Record the voltage as the “passed self-test voltage”.

(6) Make sure correct RID, TXID, and VID are set (on PETS).

(7) Send a NO-OP command.

(8) Send a MONITOR command.

(9) Record the RSTO voltage as the “Command Accepted Sequence voltage”.

(10) Drop MONITOR command.

(11) Send a Wireless Commit command.

(12) Send a MONITOR command.

(13) Record the RSTO voltage as the “Command Valid Sequence voltage”.

(14) Drop MONITOR command.

(15) On the PETS, set the correct RID, TXID, and VID; and an invalid command.

(16) Send a MONITOR command.

(17) Record the RSTO voltage as the “VID Valid Sequence voltage”.

(18) Drop MONITOR command.

(19) On the PETS, set the correct RID and TXID, and incorrect VID.

(20) Send a MONITOR command.

(21) Record the RSTO voltage as the “TXID Valid Sequence voltage”.

(22) Drop MONITOR command.

(23) On the PETS, set the correct RID, incorrect TXID, and incorrect VID.

(24) Send a MONITOR command.

(25) Record the RSTO voltage as the “RID Valid Sequence voltage”.

(26) Drop MONITOR command.

(27) On the PETS, set an incorrect RID, TXID, and VID.

(28) Send a MONITOR command.

(29) Record the RSTO voltage as the “Frame Synch Lock Sequence voltage”.

(30) Connect 8904 Synthesizer input to the signal generator’s frequency modulation (FM) input.

(31) Set 8904 Synthesizer Channel A to the following:

(a) Frequency: 7.2 kHz.

(b) Amplitude: 1 V.

(c) Waveform: Square.

(d) Destination Out: 1.

(e) Float 1: Off.

(f) Output 1: On.

(32) Record the RSTO voltage as the “Bit Synch Sequence voltage”.

f. Pass/Fail Criteria. The RSTO output voltages will meet the criteria of Table 20.

5.16 Fail-Safe (Test Number 16).

a. Purpose. This test verifies the fail-safe circuitry of the EFTR is functional and meets the design specifications.

b. Requirement. The fail-safe circuitry of the EFTR will meet the design specification.

c. Test Equipment Requirements. A second power supply capable of supplying the fail-safe enable voltages and a method of controlling the application of voltage to within one millisecond. An instrument is required to measure the delay between the application of RF or lowering the input voltage and the TERMINATE output.

d. Setup. Connect the UUT to the test equipment as shown in Appendix A and Table 22.

TABLE 22. TEST SETUP FOR FAIL-SAFE

DEVICE	SETTINGS
RF Generator	
Power Output	-95 dBm
Frequency	F_o
Deviation	± 50 kHz
UUT Configuration	
Configuration Location	0
Transmitter ID (TXID)	2
Range ID (RID)	1
Vehicle ID (VID)	11
Command Counter (CC)	0
Failsafe	On
Fail-Safe Timer	8 seconds
Low Voltage	23 volts
Power Supply	
Voltage	28 V

e. Procedure.

(1) Connect second power supply.

(2) Pull up EFTS GUI (Figure 3).

(3) Click “Receiver Power On”.

(4) Send Check Channel command.

(5) Send NO-OP command.

(6) Set PS2 “Voltage Set” to 5 V.

(7) Set PS2 “Output Set” to ON.

(8) Click PS2 “Set”.

(9) Close switch 109.

(10) Open switch 109. Verify the FSO goes from low to high within the specified time and the Fail-Safe TLM signal goes high within the specified safe time.

(11) Drop Check Channel for 4 seconds and then re-send check channel.

(12) Wait 16 seconds and verify that ARM and TERMINATE outputs remain off and FSO is high.

(13) Drop Check Channel and measure the time from removal of Check Channel to when the ARM and TERMINATE outputs turn ON. Record the time as the "fail-safe loss of communications time".

(14) Verify the FSO is low.

(15) Click "Receiver Power Off".

(16) Click "Receiver Power On".

(17) Send Check Channel command.

(18) Send NO-OP command.

(19) Set PS2 "Voltage Set" to 5 V.

(20) Set PS2 "Output Set" to ON.

(21) Click PS2 "Set".

(22) Close switch 109.

(23) Open switch 109.

(24) Turn OFF the RF input and measure the time from removal of the RF to when the ARM and TERMINATE outputs turn ON. Record the time as the "fail-safe loss of RF time".

(25) Click "Receiver Power Off".

(26) Click "Receiver Power On".

(27) Turn RF on (-95 dBm).

(28) Send Check Channel command.

(29) Send NO-OP command.

(30) Lower the EFTR primary DC voltage by clicking the “Volt dec by 1” button, until voltage is down to 21 V. At each increment verify the EFTR does not have ARM and TERMINATE outputs.

(31) Set PS1 “Voltage Set” to 28 V.

(32) Set PS1 “Output Set” to ON.

(33) Click PS1 “Set”.

(34) Set PS2 “Voltage Set” to 5 V.

(35) Set PS2 “Output Set” to ON.

(36) Click PS2 “Set”.

(37) Close switch 109.

(38) Open switch 109.

(39) Lower the primary DC voltage by clicking the “Volt dec by 0.5” button, until the EFTR has an ARM and TERMINATE output or until voltage is at 21 V. Record the input voltage when the ARM and TERMINATE outputs occur as the “fail-safe low voltage”.

(40) Click “Receiver Power Off”.

(41) Click “Receiver Power On”.

(42) Set PS1 “Voltage Set” to 28 V.

(43) Set PS1 “Output Set” to ON.

(44) Click PS1 “Set”.

(45) Send Check Channel.

(46) Send No-Op.

(47) Set PS2 “Voltage Set” to 5 V.

(48) Set PS2 “Output Set” to ON.

(49) Click PS2 “Set”.

(50) Close switch 109.

(51) Open switch 109.

(52) Lower the EFTR input voltage to 22.5 V and measure the time from when the voltage is lowered to when an ARM and TERMINATE output occurs. Record the time as the "fail safe low voltage time".

(53) Repeat steps 4 through 51 using the maximum specified voltage and pulse width for the fail-safe enable pulse.

(54) Click "Receiver Power Off".

(55) Click "Receiver Power On".

(56) Set PS1 "Voltage Set" to 28 V.

(57) Set PS1 "Output Set" to ON.

(58) Click PS1 "Set".

(59) Set PS2 "Voltage Set" to 0.5 V.

(60) Set PS2 "Output Set" to ON.

(61) Click PS2 "Set".

(62) Close switch 106.

(63) Close switch 200.

(64) Send Check Channel command.

(65) Send Fail-Safe Enable (FSE) command. Verify Fail-Safe TLM goes high and FSO goes high.

(66) Drop Check Channel command. Verify that after the Loss of Communication time, the ARM and Terminate outputs are On and the FSO goes low.

(67) Send Check Channel. Verify the ARM and TERMINATE outputs are still on and the Check Channel monitor output is on.

(68) Drop FSE command.

(69) Send MONITOR command. Verify the Monitor output is ON along with the ARM and TERMINATE outputs.

(70) Drop MONITOR command.

(71) Send OPTIONAL command. Verify the OPTIONAL output is ON along with the ARM and TERMINATE outputs.

(72) Drop OPTIONAL command.

(73) Send a Command UNLATCH command. Verify the Optional output turns off and the ARM and TERMINATE outputs remain ON.

(74) Drop Command UNLATCH command.

(75) Send Fail-Safe Disable command. Verify the ARM and TERMINATE outputs turn off and the Fail-Safe TLM output goes low.

(76) Drop Fail-Safe Disable command.

(77) Set PS2 “Voltage Set” to 5 V.

(78) Set PS2 “Output Set” to ON.

(79) Click PS2 “Set”.

(80) Send Check Channel command.

(81) Send Fail-Safe Enable command. Verify the Fail-Safe TLM and FSO go high.

(82) Drop Check Channel command.

(83) Send NO-OP command. Verify after the Loss of Communications time, the FSO goes low and the ARM and TERMINATE outputs remain off.

(84) Set PS2 “Voltage Set” to 0.5 V.

(85) Set PS2 “Output Set” to ON.

(86) Click PS2 “Set”. Verify the ARM and TERMINATE outputs turn on.

(87) Send Check Channel command.

(88) Send Fail-Safe Disable command.

(89) Verify Arm and Terminate drop out.

(90) Open switch 106.

(91) Open switch 200.

f. Pass/Fail Criteria. The fail-safe loss of tone time, loss of RF time, loss of power time, and fail-safe low voltage will meet the values in the specification. The TERMINATE output will not occur when fail-safe has not been enabled or the tone or RF are not lost for the minimum specified times.

5.17 Leakage Current (Test Number 17).

a. Purpose. This test measures the amount of direct current that the EFTR outputs on its command outputs in the un-commanded state. This measurement is critical to other components that interface with the EFTR.

b. Requirement. The command output leakage current shall not exceed ± 50 microamperes.

c. Test Equipment Requirements. If a DC ammeter is used, it will have a worst-case resolution of 1 microamps and an accuracy of at least one percent. If a DC voltmeter is used, it will have a worst-case resolution of 1 millivolt and a DC accuracy of at least one percent. If method two is used, the resistor will have a specified accuracy of ± 1 percent.

d. Setup. Connect the UUT to the test equipment as shown in Appendix C and Table 23.

TABLE 23. TEST SETUP FOR LEAKAGE CURRENT

DEVICE	SETTINGS
RF Generator	
Power Output	Off
Frequency	F_o
Deviation	± 50 kHz
Modulation	Off
UUT Configuration	
Configuration Location	0
Transmitter ID (TXID)	2
Range ID (RID)	1
Vehicle ID (VID)	11
Command Counter (CC)	0
Failsafe	Off
Power Supply	
Voltage	28 V

e. Procedure.

(1) Connect the breakout box to the EFTR.

(2) Pull up EFTS GUI (Figure 3).

(3) Click “Receiver Power On”.

(4) Connect multimeter pins 2 and p7.

(5) Record reading as “Optional Amps”.

(6) Connect multimeter pins 2 and 8.

(7) Record reading as “Monitor Amps”.

(8) Connect multimeter pins 2 and 9.

(9) Record reading as “Arm Amps”.

(10) Connect multimeter pins 2 and 10.

(11) Record reading as “Terminate #1 Amps”.

(12) Connect multimeter pins 2 and 11.

(13) Record reading as “Terminate #2 Amps”.

f. Pass/Fail Criteria. No single command output leakage current shall exceed ± 50 microamperes.

5.18 Output Load Characteristics (Test Number 18).

a. Purpose. This test verifies the EFTR command and monitor outputs are capable of providing the specified power output into the specified load impedance characteristics.

b. Requirement. The EFTR shall be capable of outputting the specified power for the specified time to the specified load on each command output at any EFTR input power supply voltage level between the minimum and maximum voltages.

c. Test Equipment Requirements. The loads placed on the EFTR outputs must be as specified in the procurement specification. The DC power source must be capable of providing the direct current necessary to sustain the EFTR power requirements.

d. Setup. Connect the UUT to the test equipment as shown in Appendix C and Table 24.

TABLE 24. TEST SETUP FOR OUTPUT CIRCUIT LOAD CHARACTERISTIC

DEVICE	SETTINGS
RF Generator	
Power Output	-47 dBm
Frequency	F_o
Deviation	± 50 kHz
UUT Configuration	
Configuration Location	0
Transmitter ID (TXID)	2
Range ID (RID)	1
Vehicle ID (VID)	11
Command Counter (CC)	0
Failsafe	Off
Power Supply	
Voltage	28 V, 22 V, and 36 V

e. Procedure.

(1) Pull up EFTS GUI (Figure 3).

(2) Click “Receiver Power On”.

(3) Set “PS1 Voltage” to 28 V.

(4) Connect the breakout box to the EFTR.

(5) Set electronic load.

(a) Select current.

(b) Input 0.9.

(c) Select “Input ON/OFF” to turn On.

(6) Send OPTIONAL command.

(7) Measure and record voltage at pins 2 and 7.

(8) Click “Optional” (GUI).

(9) Close switch 409.

(10) Measure and record voltage at pins 2 and 7.

(11) Record difference in voltage between readings from step 7 and 10. Voltage drop should be less than or equal to 3 V.

(12) Open switch 409.

(13) Click “Disconnect All” button.

(14) Repeat steps 6 through 13 for other commands.

(a) MONITOR (pins 2 and 8).

(b) ARM (pins 2 and 9).

(c) TERMINATE #1 (pins 2 and 10).

(d) TERMINATE #2 (pins 2 and 11).

(15) Set “PS1 Voltage” to 22 V.

(16) Repeat steps 4 through 14.

(17) Set “PS1 Voltage” to 36 V.

(18) Repeat steps 4 through 14.

f. Pass/Fail Criteria. The EFTR monitor and command outputs will meet the output power and timing requirements of the procurement specification when operating into the specified load.

5.19 Image and Spurious Response Rejection (Test Number 19).

a. Purpose. This test verifies that the EFTR RF section can reject the image frequency and other signals outside the EFTR's specified 60 dB bandwidth.

b. Requirement. The EFTR’s RF selectivity shall reject the image frequency and other frequencies within the frequency spectrum from 10 MHz to 1000 MHz (omitting the frequency band within the 60-dB bandwidth) by at least 60 dB, minimum, below the specified threshold sensitivity.

c. Test Equipment Requirements. The RF signal generator must have a frequency resolution and accuracy of at least 1 kHz and an amplitude resolution of 0.1 dB with a minimum accuracy of 0.5 dB. The voltmeter used to measure the SSTO must have at least 4½ digits and have a minimum accuracy of one percent.

d. Setup. Connect the UUT to the test equipment as shown in Appendix A and Table 25.

TABLE 25. TEST SETUP FOR IMAGE AND SPURIOUS RESPONSE REJECTION

DEVICE	SETTINGS
RF Generator	
Power Output	-107 dBm
Frequency	F_o (will be varied from 10 MHz to 1000 MHz)
Deviation	Off
UUT Configuration	
Configuration Location	0
Transmitter ID (TXID)	2
Range ID (RID)	1
Vehicle ID (VID)	11
Command Counter (CC)	0
Failsafe	Off
Power Supply	
Voltage	28 V

e. Procedure. Run Test # 15 on the automated tester.

f. Pass/Fail Criteria. The image rejection and the rejection of all other frequencies outside the 60 dB bandwidth of the EFTR shall be at least 60 dB.

5.20 Center Frequency /Tuneability (Test Number 20).

a. Purpose. This test verifies that the Receiver/Decoder is programmable to operate at 421, 425, 425.1, 428, and 450 MHz.

b. Requirement. The EFTR shall be tunable over the frequency range 420-450 MHz.

c. Test Equipment Requirements. The RF generator must be tunable over the frequency range of 420 to 450 MHz and have a worst-case resolution of 1 kHz and a minimum accuracy of ± 0.1 kHz.

d. Setup. Connect the UUT to the test equipment as shown in Appendix B and Table 26.

e. Procedure.

(1) Configure the EFTR to a center frequency of 421 MHz.

(2) Pull up EFTS GUI (Figure 3).

(3) Set “PS1 Voltage” to 28 V.

TABLE 26. TEST SETUP FOR CENTER FREQUENCY/TUNEABILITY

DEVICE	SETTINGS
RF Generator	
Power Output	-107 dBm
Frequency	421, 425, 425.1, 428 and 450 MHz
Deviation	± 50 kHz
UUT Configuration	
Configuration Location	0
Transmitter ID (TXID)	2
Range ID (RID)	1
Vehicle ID (VID)	11
Command Counter (CC)	0
Failsafe	Off
Power Supply	
Voltage	28 V

(4) Set the Signal Generator to 421 MHz.

(5) Click “Receiver Power On”.

(6) Connect “Trigger Out” (PETS) to Channel 2 (oscilloscope).

(7) Click “Monitor” (GUI).

(8) Set RF Signal Generator to -107 dBm.

(9) Send CHECK CHANNEL command.

(10) Send MONITOR command.

(11) Select “Recall #9” on oscilloscope.

(12) Set oscilloscope to run.

(13) Wait 20 seconds to see if oscilloscope triggers.

(14) Record data if oscilloscope is triggered.

(15) Drop MONITOR command.

(16) Drop CHECK CHANNEL command.

(17) Click “Receiver Power Off”.

(18) Repeat steps 2 through 17 for the EFTR center frequencies of 425 MHz, 425.1 MHz, 428 MHz, and 450 MHz.

(19) Configure EFTR back to standard conditions (425 MHz).

f. Pass/Fail Criteria. The EFTR shall meet the required MER of $1x10^{-3}$ over the tunable the frequency range 420-450 MHz.

6. DATA REQUIRED.

6.1 Data Report.

a. Summary Test Report. If the receiver passes all tests, a summary test report shall be produced and sent to the receiver owner with the test sample. The summary report will contain, at a minimum, a summary of all tests performed and shall specify critical parameters such as signal strength.

b. Complete Test Data Report. A complete data report shall be generated with all test results and will be stored on computer memory. The report shall be stored for a period of 5 years, or until the unit is expended or the program is ended.

6.2 Failure Report.

The occurrence of any failure during these tests must be reported to the LRSO within five working days. This requirement applies to all testing beginning with, and subsequent to, the start of the formal acceptance test procedure (ATP). Formal ATP in this case refers to tests conducted that demonstrate the acceptability of units for delivery from the vendor. Failure reporting must be accomplished in accordance with RCC Document 319.

a. Soft Failures. Soft failures result when the UUT fails to meet the specification but operates otherwise. Soft failures that are present or occur during testing do not require the test to be halted. Testing may continue; however, the failure must be verified and analysis must be conducted to ensure that the failure was not induced by the test hardware or setup.

b. Hard Failures. Hard failures result when the UUT fails to continue to operate, causes the primary power to exceed its set limits, or causes the test set to fail. Hard failures generally result when a component within the UUT has failed. Hard failures will require the test to be haulted. The failure will be verified, if possible, but care must be given to not cause further damage to the UUT or to the test instrumentation. The test set will be examined in order to determine that it did not cause the failure.

c. Both soft and hard failures will be reported in writing to the LRSO on the Airborne Flight Termination System Failure Report form shown in Figures 7 and 8. Locally-generated

and computer-generated forms are acceptable as long as the required data are reported completely.

AIRBORNE FLIGHT TERMINATION SYSTEM FAILURE REPORT *(For instructions see reverse)*		
REPORTING ACTIVITY		
1. REPORT DATE	2. FAILURE DATE	3. ORGANIZATION
ITEM Identification		
4. NOMENCLATURE		5. MODEL
6. PART NUMBER	7. SERIAL NUMBER	8. ITEM ☐ NEW ☐ REPAIRED
9. DATE MANUFACTURED	10. FSN	11. SYSTEM REFERENCE
ITEM SOURCE		
12. VENDOR		13. CONTACT NUMBER
DEFECT DESCRIPTION		
14. NEXT HIGHER ASSEMBLY		15. END ITEM
TEST IDENTIFICATION		
16. TEST LOCATION		17. TYPE OF TEST
18. TEST PROCEDURE		
ACTION TAKEN		
19. ☐ DEFECTIVE ITEM REPAIRED AND RETURNED TO SERVICE *(Explain in Remarks)*		20. ☐ DEFECTIVE ITEM DISPOSED *(Explain in Remarks)*
21. REMARKS/COMMENTS *(a. Circumstances prior to failure. b. Description of failure area/mode. c. Action taken.)*		
22. TYPE/PRINTED NAME OF PERSON SIGNING	SIGNATURE	PHONE NUMBER

Figure 7. Airborne Flight Termination System failure report (page 1 of 2).

INSTRUCTIONS

BLOCK NO.	
1.	**REPORT DATE: Enter date report signed and forwarded.**
2.	**FAILURE DATE: Enter date failure occurred.**
3.	**ORGANIZATION Identify organization initiating failure report.**
4.	**NOMENCLATURE: Enter name of failed component or system.**
5.	**MODEL: Enter model identification.**
6.	**PART NUMBER: Enter manufacturer's part number.**
7.	**SERIAL NUMBER: Enter serial number of item.**
8.	**ITEM: NEW OR REPAIRED: Check applicable block to indicate if item was previously repaired or overhauled by the manufacturer, or if item was new. Enter date of repair or overhaul if applicable. Date should be obtainable from the serviceable tag or label on the packaging container.**
9.	**DATE OF MANUFACTURE: Enter date item was manufactured, if available.**
10.	**FSN: Enter federal stock number.**
11.	**SYSTEM REFERENCE: Enter item's flight termination system reference , e.g., flight termination receiver "A" or "B," Battery "A" or "B."**
12.	**VENDOR: Enter name of manufacturer.**
13.	**CONTRACT NUMBER: Enter contract number obtained from the serviceable tag or label, if possible. This information will assist in follow-up analysis, if required.**
14.	**NEXT HIGHER ASSEMBLY: Enter the major component or components on which the defective item was installed when other than a major end item, such as a missile.**
15.	**END ITEM: Enter the associated missile type and serial number, if applicable.**
16.	**TEST LOCATION: Identify test location, e.g., contractor's plant or launch pad.**
17.	**TYPE OF TEST: Identify type test , e.g., bench test, RF, or closed loop-test.**
18.	**TEST PROCEDURE: Identify test procedure by title and number including revision number.**
19.	**DEFECTIVE ITEM REPAIRED AND RETURNED TO SERVICE: Check this block if the item is repaired locally and indicate under block 21 (Remarks) what malfunction corrective action was taken.**
20.	**DEFECTIVE ITEM DISPOSED: Check this block if item is scrapped or returned to vendor for malfunction correction. Indicate under block 21 (Remarks) what disposition is made and include identification reference to all associated unsatisfactory and rejection reports.**
21.	**REMARKS/COMMENTS: Provide description outlining failure area/mode, circumstances prior to failure, and details in conjunction with blocks 19 and 20.**
22.	**Self-explanatory.**

Figure 8. Airborne Flight Termination System failure report (page 2 of 2).

7. POST TEST INSPECTION / PACKING / SHIPPING.

7.1 Post Test.

7.1.1 Once the EFTRs complete Certification Testing, receiver lab personnel will perform a post test inspection of each EFTR and annotate any adverse results on test data sheet. Several steps are to be taken in order to ensure the safe and prompt return of the receivers to the vendor. Care should be taken to make sure all units are packaged and shipped properly.

a. Before commencing the process of preparing the units for shipment, personnel shall be properly grounded, and the units placed on grounded conductive surfaces. ESD compliance is critical for the protection of the EFTR(s).

b. EFTR(s) are to be visually inspected using the same procedures described in paragraph 3.2. The results of this inspection should be recorded in the data log sheet. This log sheet should be separate from the inspection performed on the unit prior to testing.

c. All plastic connector covers shall be placed back onto the receivers. If the EFTR(s) were received with no plastic covers, then new covers provided by the WSMR Receiver Lab will be used in order to insure that ALL receivers are shipped in compliance to laboratory standards.

d. The EFTR(s) will be placed inside ESD conductive/anti-static bags, and sealed with ESD compliance static tape. An “ESD Sensitive Electronics” sticker shall be placed on the bag and/or on the shipping box as well.

e. The receivers will be packed in shipping boxes lined with foam. The boxes will be checked for snugness with the option of using tape to secure them. The smaller individual shipping boxes (each with an EFTR) will be placed in a larger cardboard box. Bubble wrap and foam will be used to secure a snug fit within the larger box.

f. Pass/fail data for the EFTR(s) will be included in the box to be shipped.

(1) If the unit passed certification, four data summary sheets for each receiver will be provided. The summary sheets will summarize the results of the certification performed at pre-ambient, cold, hot, and post-ambient temperatures. An “ACCEPTED” sticker with the date the post-ambient test was performed will be affixed on the receiver.

(2) If the unit failed certification, the relevant failure data, as well as a failure report, will be provided. The failure report will specify the conditions and reason the unit was rejected. A “REJECTED” sticker with the date of rejection and abbreviated reason of failure will be placed on the EFTR.

7.1.2 A shipping document will be created listing the manufacturer’s model and serial number of the unit(s) to be shipped, as well as the shipping address to include a point of contact (POC) and phone number. One copy of the shipping document will be placed inside the box, and a

second copy will be kept on file. A third copy will be given to shipping and receiving at the time the box is shipped.

7.1.3 The EFTR(s) are to be properly logged out of the inventory control database. (NOTE: **This needs to be done accurately because an error could result in a condition where the location of the receiver is unknown.**) The units must be identified clearly and accurately, along with all related information that pertains to shipping the units. The entry of the units into the database must consist of the following information:

a. Log entry number.

b. Date EFTR(s) shipped.

c. Name of person shipping/packing the EFTR(s).

d. The name of the company or organization that owns the EFTR(s).

e. The name of the program that will be the end user of the EFTR(s).

f. The EFTR manufacture, model number, and serial number.

g. Shipping information (how it was shipped).

h. Information on shipping destination.

7.1.4 The larger outer box containing the receiver(s) will then be securely taped up. Contents in the box should be snug, with no indication of rattling inside the box. Once the box is secured, it can be taken to shipping and receiving along with the shipping document.

7.2 Shipping/Packing Work Area.

a. Packaging/Shipping Preparation Area. The EFTR laboratory shall have a separate area from the testing location that is designated specifically for packing of receivers. This station shall be EDS protected with ground straps and grounded work mats. The packing area shall consist of a packaging work bench with easy access to packaging tools and materials. This area must be maintained organized and clean.

b. Preparing the Receiver for Shipping. Each receiver certification laboratory must keep in stock an array of packing supplies to insure that EFTR’s are not damaged during shipping. Damage can be caused by transportation environments such as compression, shock, vibration, or climatic or handing environments such as ESDs. All receivers shall be shipped with connector plastic caps, covered with an ESD static shield bags, sealed with ESD conductive tape, and the box they are shipped in must have a be labeled with a Caution Electrostatic Sensitive Device sticker.

c. Packing the Receiver. All EFTRs must be properly packaged for shipping or transport with appropriate packaging techniques and materials. All packing must be done in a way where the receiver is padded and protected from adverse shock or vibration or compression environments. If the receiver is to be hand carried from the receiver certification laboratory to the assembly facility, the receiver must be ESD packaged and boxed as well. Packing shall consist of placing or wrapping the ESD sealed EFTR into packing padding material and placing it in a box. Cushioning material can consist of bubble wrap foam, or plastic foam. The use of polystyrene “peanuts” is not acceptable. The receiver must be cushioned at least 2.5 cm on each side, and the box must be structurally sound to insure it can withstand adverse transport compression forces and will not come apart during shipping. The box is then sealed and labeled with shipping label and with cautionary ESD sensitive sticker. The ESD sealed receiver can also be placed in a box designed for electronic component shipping where the padding is already attached to the shipping box.

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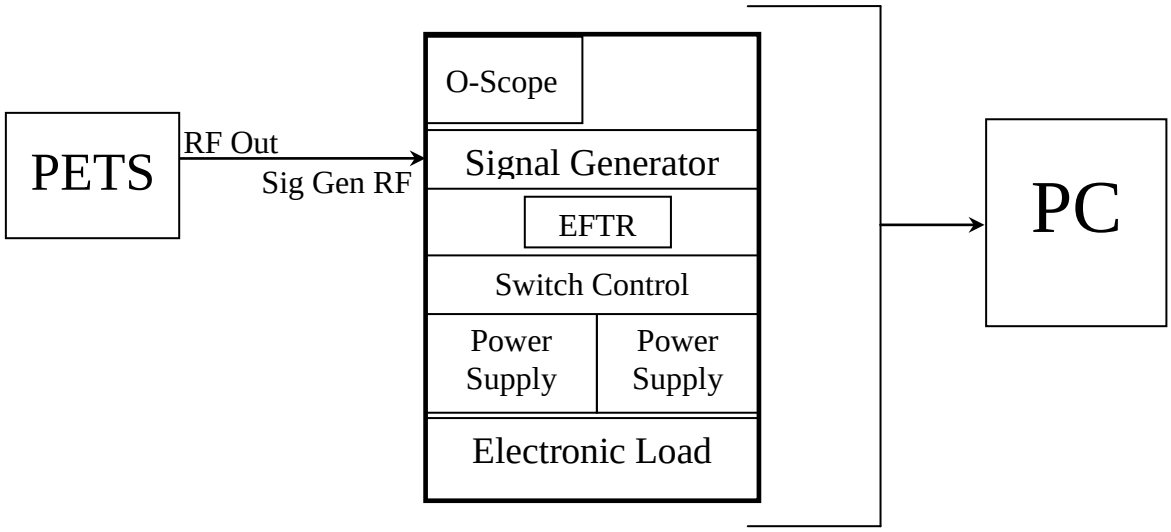
APPENDIX A. GENERAL TEST SETUP.



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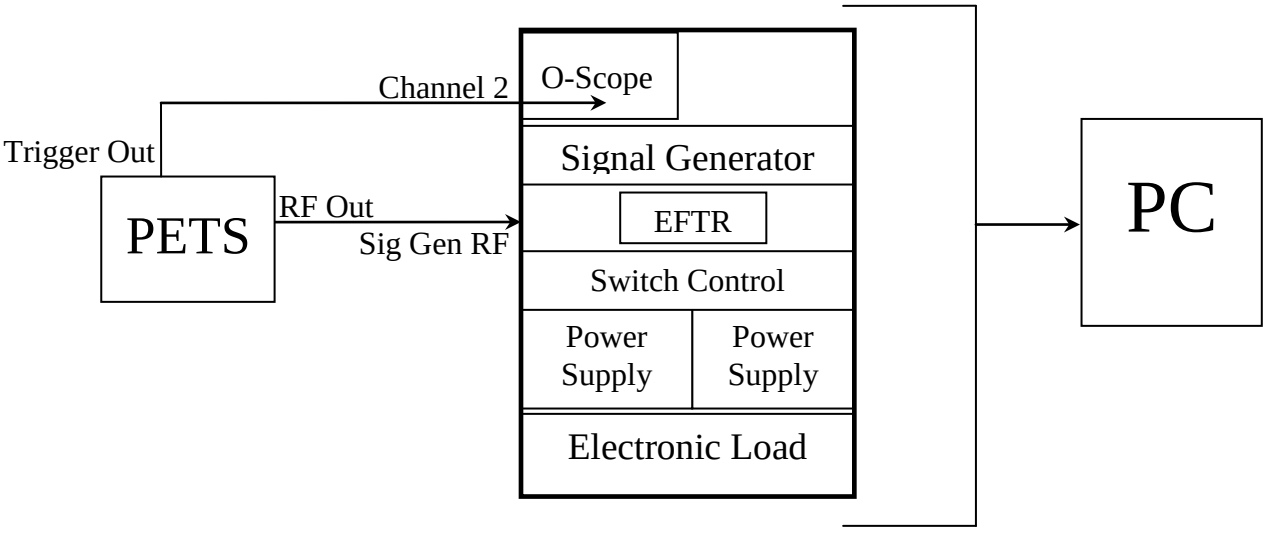
APPENDIX B. TRIGGER OUT TEST SETUP.



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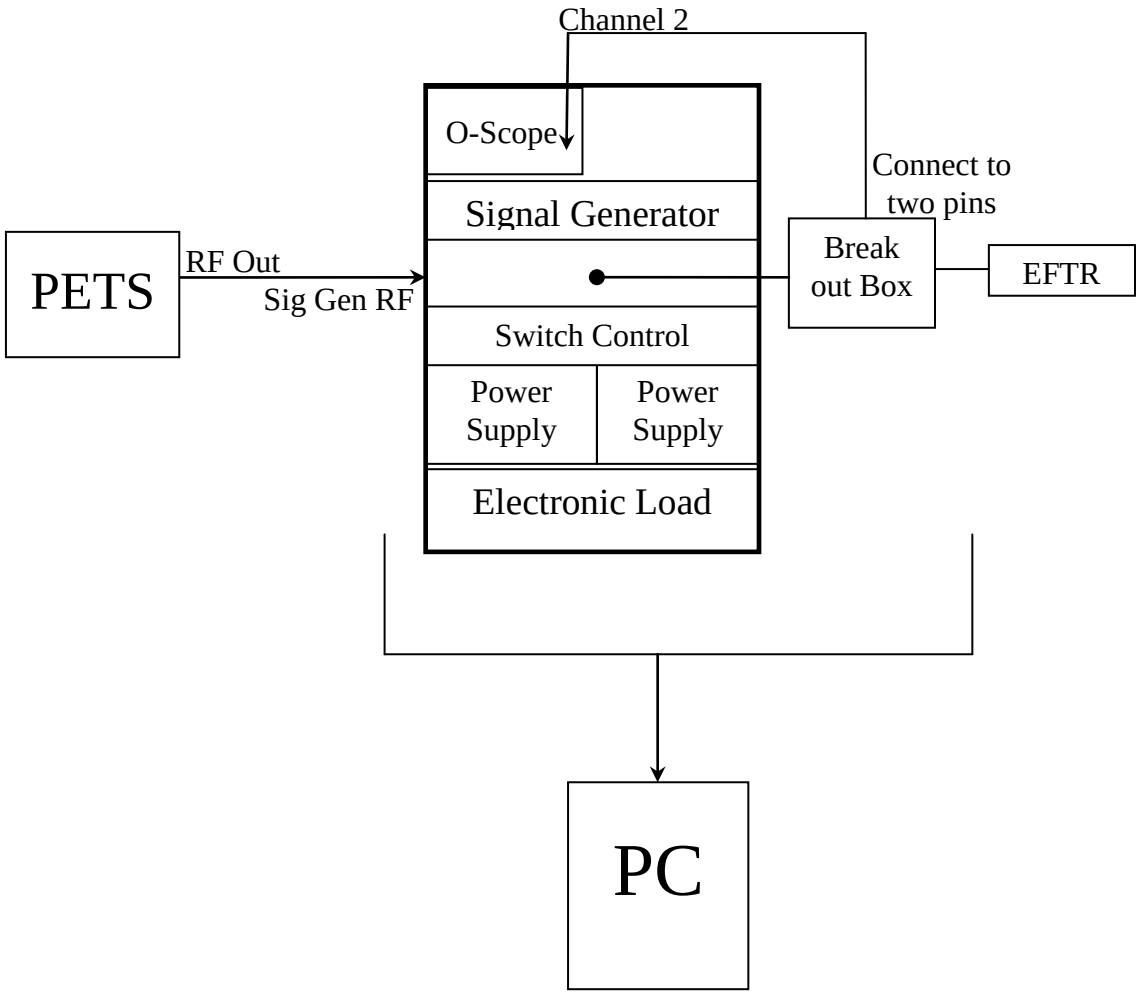
APPENDIX C. ACQUISITION/REACQUISITIION TIME AND LEAKAGE CURRENT TEST SETUP.



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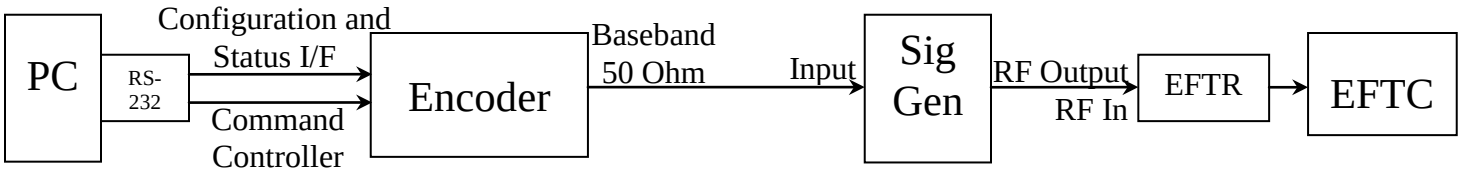
APPENDIX D. INVERTED MODULATION TEST SETUP.



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APPENDIX E. GLOSSARY.

Term	Definition
Acceptance Testing	Required formal tests conducted to demonstrate acceptability of the unit for delivery. These tests demonstrate performance to purchase specification requirements and act as quality control screens to detect deficiencies in workmanship and materials. The successful completion of such tests denotes acceptance of the unit by the procurement agency.
Bandwidth	The range of frequencies in which performance of an EFTR is within specified limits.
Break-out-box (BOB)	A piece of test equipment used to gain access to the various input and output pins on the connectors of the unit under test.
Capture Ratio	The capacity of an EFTR to receive and execute a command when an interfering continuous-wave (CW) carrier is simultaneously input to the EFTR. The CW signal is increased to the point where it captures the EFTR. The capture ratio is the ratio of the desired signal strength to the interfering signal strength at the time of capture.
Certification Testing	A laboratory-controlled environmental test where the unit is verified to comply with design specifications. This test is usually a subset of the acceptance test and certifies the unit for flight use. It has a specified certification period (in days) whereby, if the unit is not flown within the specified time, it must be recertified.
CW Bandwidth	The EFTR CW response at assigned center frequency versus response above and below assigned carrier frequency when the RF input level is increased 60 dB from threshold.
Decibel (dB)	A unit of relative power. The decibel ratio between two power levels, P1 and P2, as defined by the relation $dB=10 \log_{10} (P1/P2)$.
dBm	A unit used to express an arbitrary power level in terms of its decibel ratio to a reference level of one milliwatt.
Development Testing	These tests validate hardware design concepts and assist in the evolution of designs from the conceptual to the operational phase. The objective is to identify hardware problems early in their design evolution, so that any required actions can be taken prior to the beginning of formal qualification testing and production fabrication.

APPENDIX E. GLOSSARY.

Term	Definition
Deviation	a. A noncompliance to RCC STD 319. A deviation does not comply with or meet the intent of the written requirement, but it also does not introduce any significant safety risk. b. A departure from a prescribed specification. c. See Modulation.
Deviation Sensitivity	The amount of FM deviation required to cause an EFTR to correctly execute a command.
Fail-Safe	A method built into flight termination systems that will activate an output upon the loss of power and/or RF signal and/or tone.
Fail Safe Bypass	A method used to enable or disable the fail-safe; usually referred to when the fail-safe is disabled.
Fast Fourier Transform	A Fourier transform that employs the Cooley-Tukey algorithm to reduce the number of operations.
Flight Termination	The process whereby an airborne vehicle's flight trajectory is stopped. Flight termination does not imply a method of achieving termination.
Enhanced Flight Termination Receiver	A generic term used to define the RF radio receiver/decoder employed on flight vehicles to receive Enhanced Flight Termination System encoded commands.
Flight Termination System	The entire system on an airborne vehicle used to receive, decode, and execute the command signals. It includes all wiring, power systems, and methods or devices used to terminate flight.
Inter-Range Instrumentation Group (IRIG)	Original standing groups formed by the Range Commanders Council. The IRIG is an older term that has been replaced by individual standing groups such as the Range Safety Group (RSG).
Maximum Usable RF Input	The capacity of an EFTR to properly respond to commands after being subjected to high RF input of a specified level. Also known as blocking.
Meets Intent Compliance	When a design does not meet the exact RCC STD 319 requirement, but it does meet the intent of the requirement.

APPENDIX E. GLOSSARY.

Term	Definition
Modulation	The process by which an RF carrier is varied in accordance with a modulation wave/signal. In the case of an EFTR, frequency modulation (FM) is employed. In FM the carrier is shifted about the assigned frequency at an interval equal to the modulation tone frequency (RCC tone) or the rms sum of the tones when more than one tone is used. The distance that the carrier is shifted is equal to the amplitude of the modulation tone or the rms sum of all the tones. Example: The tone frequency is 8.00 kHz and the amount of deviation is 30 kHz. The carrier is shifting at a rate of 8.00 kHz and a distance of 30 kHz.
Nominal Sensitivity	The minimum specified RF input level to the EFTR (when properly modulated) that must produce the desired outputs. Also known as the "factory-guaranteed" sensitivity level. The nominal level is that level specified as the minimum in the procurement specification. It is not the actual measured level.
Operating Frequency	The RF center frequency (F_o) in a CW mode that has been assigned by the procurement specification. Also referred to as the assigned frequency.
Operational Bandwidth	The overall range of frequencies, plus and minus added together, and representing the amount that a properly modulated signal operating frequency can be varied, and the limits within which an EFTR will continue to properly receive and decode a signal.
Power Divider/Splitter	Used to divide RF input power to more than two output ports. Dividers are available that have multiple input ports and multiple output ports and are commonly used to distribute the output of the antennas to the input of the EFTRs. They provide attenuation to the signal in the form of both insertion and coupling losses. Also referred to as couplers.
Primary Battery	A battery not intended to be recharged that is disposed of in controlled conditions when it has delivered all its electrical energy.
Qualification Testing	The testing of a device or component to demonstrate that the design, manufacturing, and assembly processes have resulted in hardware and software that conform to the specification.

APPENDIX E. GLOSSARY.

Term	Definition
Quiescent Level	A condition of a circuit element which has no input signals so that it does not perform its active function.
Range Prelaunch Testing	These tests involve component-level and system-level testing procedures.
Redundancy	Two or more components, circuits, assemblies, or systems that serve the same objective.
Resistance and Isolation	The resistance between EFTR terminals that are common (resistance) and those that are not common (isolation).
Response Time	The period of time from reception of a command signal at an EFTR until the time of an output.
RF Center Frequency	The frequency to which the receiver is tuned. The frequency halfway between the cut-off frequencies of the receiver.
RF Level Monitor	Same as signal strength telemetry output.
Signal Strength Telemetry Output (SSTO)	a. A voltage that is directly proportional to the amount of RF signal the EFTR is receiving. The EFTR uses its automatic gain control (AGC) voltage as the basis for SSTO voltage. This output signal is usually scaled from 0 to 5 VDC and is also commonly referred to as AGC or signal strength telemetry (SST). The preferred acronym is SSTO. b. A voltage plot of the EFTRs signal strength monitor voltage versus RF input signal strength.
Telemetry	Measurement of data with the aid of a transmission medium that permits measurements to be interpreted at a distance from the detector. The telemetry system is used for range safety system real-time status reporting.
Terminate Command	A command which, when received and decoded, will cease the flight profile of an airborne vehicle.
Threshold Sensitivity	The actual measured minimum RF, properly modulated, required to produce a desired output from an EFTR. This sensitivity is different from the nominal sensitivity and is usually a lower RF level. Also referred to as RF threshold and command threshold.

APPENDIX E. GLOSSARY.

Term	Definition
Voltage Standing Wave Ratio (VSWR)	The ratio of the magnitude of the transverse electric field in a plane of maximum strength to the magnitude at the equivalent point in an adjacent plane of minimum field strength. In a perfect system, all transferred energy is accepted and coupled to the next device/system. Any unaccepted/coupled energy is reflected back to the originating device/system. Perfect VSWR is 1:1.
Waiver	Granted use or acceptance of an article that does not meet the specified requirement.

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APPENDIX F. ABBREVIATIONS.

AGC	automatic gain control
ANSI	American National Standards Institute
ATE	automated test equipment
ATP	acceptance test procedure
BOB	break-out-box
BPS	Bits Per Second
C	Celsius
CC	command counter
CCC	clear command count
CCI	command control interface
CMD	command
CRC	cyclic redundancy check
CSI	configuration and status interface
CW	continuous wave
dB	decibel
DC	direct current
DoD	Department of Defense
DoDD	Department of Defense Directive
DTD	data transfer device
EE	electronically erasable
EFTC	EFTS FTR Test Case
EFTR	Enhanced Flight Termination Receiver
EFTS	Enhanced Flight Termination System
EMI	electromagnetic interference
EMI/EMC	electromagnetic interference/electromagnetic compatibility
EMI/RFI	electromagnetic interference/radiofrequency interference
ESD	electrostatic discharge
F	Fahrenheit
F_o	center frequency
FM	frequency modulation
FSE	fail-safe enable
FSO	fail-safe output
FTR	Flight Termination Receiver
GUI	graphic user interface
Hz	hertz

APPENDIX F. ABBREVIATIONS.

ID	identification
IF	intermediate frequency
IRD	Interface Requirements Document
IRIG	Inter-Range Instrumentation Group
kHz	kilohertz
LOCL FS	loss of command link fail-safe
LOP FS	loss of power fail-safe
LRSO	Lead Range Safety Office
MER	message error rate
MHz	megahertz
MRTFB	Major Range and Test Facility Base
NASA-WFF	National Aeronautics and Space Administration-Wallops Flight Facility
NIST	National Institute of Standards and Technology
NSA	National Security Agency
PETS	portable EFTS transmitter system
POC	point of contact
PS	power supply
QTP	quality test procedure
RF	radio frequency
RCC	Range Commanders Council
RID	range identification
rms	root mean square
RSG	Range Safety Group
RSTO	receiver status telemetry output
s	second
SI	System International
SMA	Subminiature A
SST	signal strength telemetry
SSTO	signal strength telemetry output
STP	standard test parameter

APPENDIX F. ABBREVIATIONS.

TDU	transfer data unit
TLM	telemetry
TOP	Test Operations Procedure
TST	test
TXID	transmitter identification
UUT	unit under test
V	volt
VID	vehicle identification
VSWR	voltage standing wave ratio
VV	verification and validation
WSMR	US Army White Sands Missile Range

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APPENDIX G. REFERENCES.

1. Department of Defense Directive (DODD) 3200.11, Major Range and Test Facility Base (MRTFB), 27 December 2007.

2. NASA Handbook 1700.1, NASA Safety Policy and Requirements Document, 1 June 1993.

3. RCC Document 319, Flight Termination Systems Commonality Standard, August 2007.

4. ANSI/ESD S20.20, Standard for the Development of Electrostatic Discharge Control Program, 19 June 2008.

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Forward comments, recommended changes, or any pertinent data which may be of use in improving this publication to the Range Infrastructure Division (CSTE-TM), US Army Test and Evaluation Command, 2202 Aberdeen Boulevard, Aberdeen Proving Ground, Maryland 21005-5001. Technical information may be obtained from the preparing activity: US Army White Sands Missile Range, TEDT-WSR, White Sands Missile Range, NM 88002. Additional copies can be requested through the following website: http://itops.dtc.army.mil/RequestForDocuments.aspx, or through the Defense Technical Information Center, 8725 John J. Kingman Rd., STE 0944, Fort Belvoir, VA 22060-6218. This document is identified by the accession number (AD No.) printed on the first page.